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GAI CONSULTANTS INC MONROEVILLE PA  
NATIONAL DAM INSPECTION PROGRAM. TWO LICK CREEK DAM (NDI PA-285--ETC(U)  
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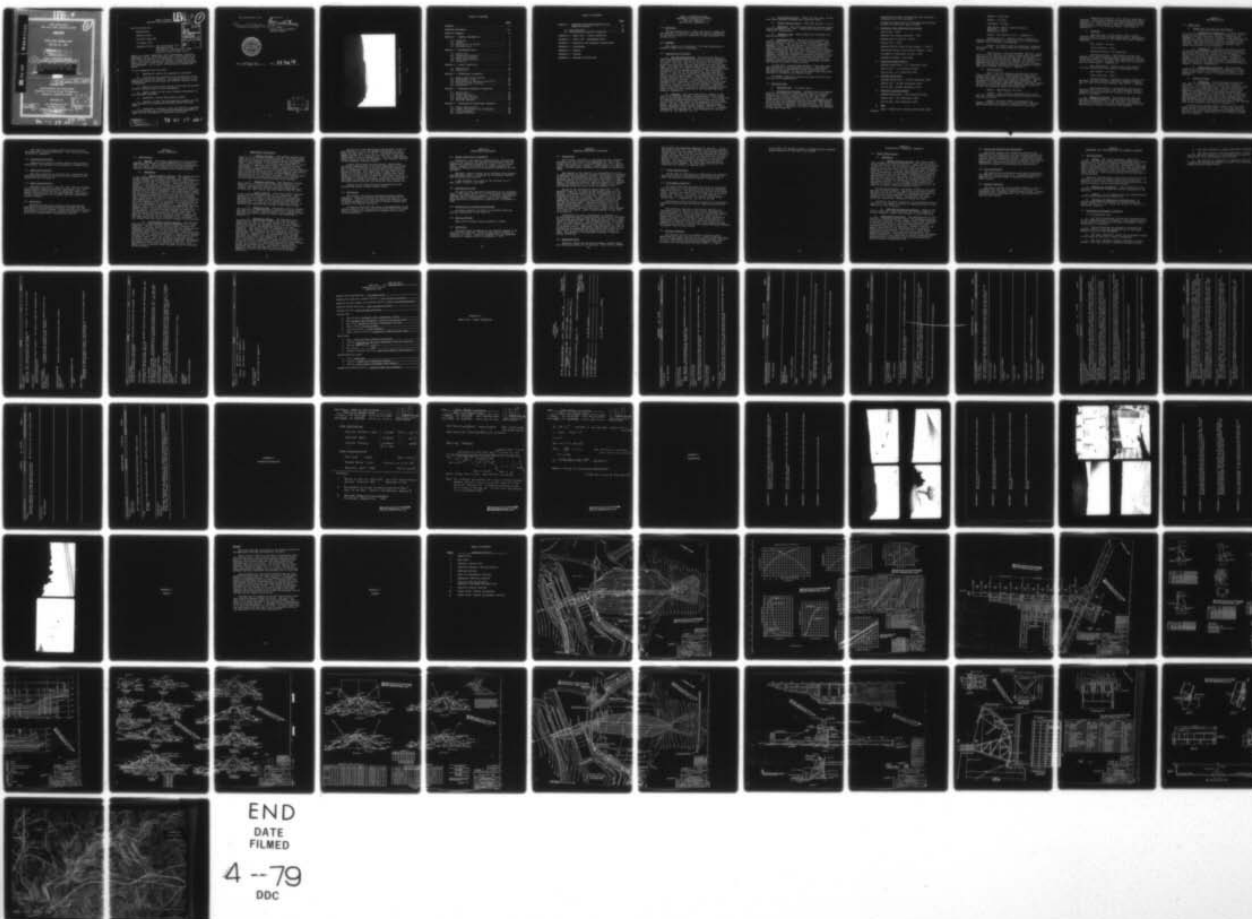
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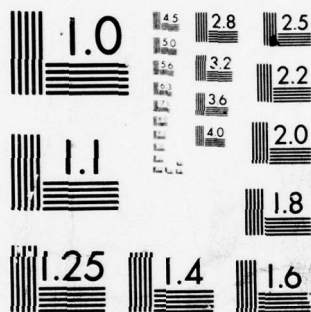
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MICROCOPY RESOLUTION TEST CHART  
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LEVEL II

OHIO RIVER BASIN  
TWO LICK CREEK, INDIANA COUNTY

PENNSYLVANIA

TWO LICK CREEK DAM

NDI No. Pa. - 285

**DISTRIBUTION STATEMENT A**

Approved for public release;  
Distribution Unlimited

**PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM.**

Two Lick Creek Dam (NDI PA-285), Ohio  
River Basin, Two Lick Creek, Indiana  
County, Pennsylvania. Phase I Inspection  
Report.

15 DACW31-78-C-0052  
PREPARED FOR

DEPARTMENT OF THE ARMY  
Baltimore District, Corps of Engineers  
Baltimore, Maryland 21203

PREPARED BY

GAI CONSULTANTS, INC.  
570 BEATTY ROAD  
MONROEVILLE, PENNSYLVANIA 15146

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PHASE I REPORT  
National Dam Inspection Program

**LEVEL II** ①

Two Lick Creek Dam

Pennsylvania

Indiana County

Two Lick Creek Dam

11 August 1978

Inspection Team - GAI Consultants, Inc.  
570 Beatty Road  
Monroeville, Pennsylvania 15146  
Contract No. DACW31-78-C-0052 ✓

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Based on a visual inspection, past performance, available engineering data, and discussions with a representative of the owner, the facility is considered to be in good condition. The primary spillway is capable of passing the flow resulting from a storm of PMF intensity without overtopping the embankment. As a result, the spillway is deemed adequate.

It is recommended that the owner:

- a. Immediately remove the embankment overgrowth.
- b. Investigate the durability and suitability of the riprap and quarry run rockfill. Conclusions relative to its suitability should be developed and remedial measures taken if necessary.
- c. Drain the water from the toe of the dam and provide positive drainage away from the embankment.
- d. Repair damage to the right abutment downstream of the emergency spillway.
- e. Establish a formal maintenance program.
- f. Develop a formal warning system to provide for the safe evacuation of downstream residents should the need arise.
- g. Establish a program to have the facility inspected on an annual basis by a registered professional engineer to check for the development of hazardous conditions.

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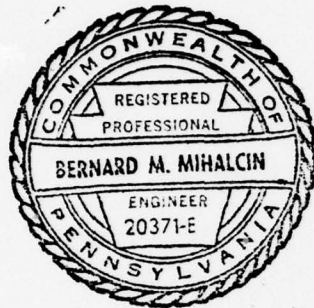


GAI Consultants, Inc.

Approved by:

Bernard M. Mihalcin  
Bernard M. Mihalcin, P.E.

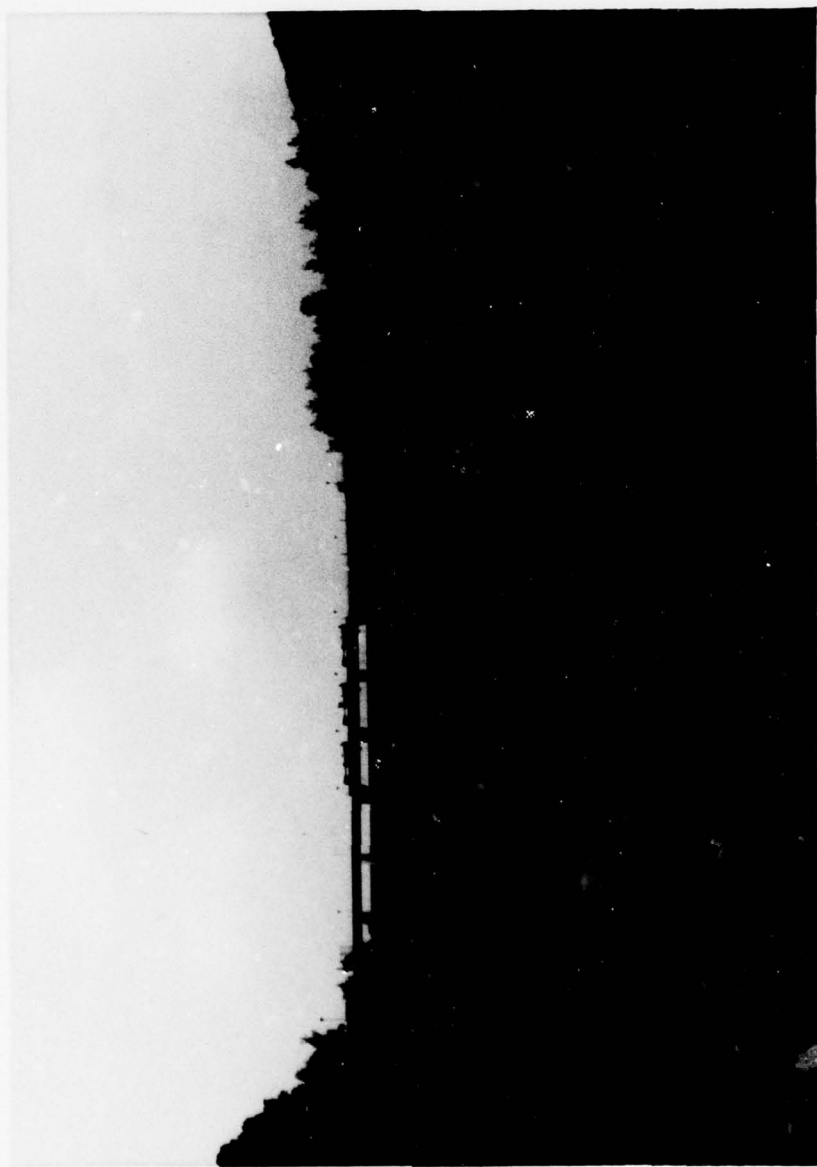
G. K. Withers  
G. K. WITHERS  
Colonel, Corps of Engineers  
District Engineer



Date 13 Sept 78

Date 22 Sep 78

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Overview Photograph of Two Lick Creek Dam

## TABLE OF CONTENTS

	<u>Page</u>
SYNOPSIS . . . . .	i
OVERVIEW PHOTOGRAPH . . . . .	iii
TABLE OF CONTENTS . . . . .	iv
SECTION 1 - GENERAL INFORMATION . . . . .	1
1.0 Authority . . . . .	1
1.1 Purpose . . . . .	1
1.2 Description of Project . . . . .	1
1.3 Pertinent Data . . . . .	2
SECTION 2 - ENGINEERING DATA . . . . .	6
2.1 Design Data . . . . .	6
2.2 Construction Records . . . . .	9
2.3 Operational Records . . . . .	9
2.4 Other Investigations . . . . .	9
2.5 Evaluation . . . . .	9
SECTION 3 - VISUAL INSPECTION . . . . .	10
3.1 Observations . . . . .	10
3.2 Evaluation . . . . .	12
SECTION 4 - OPERATIONAL PROCEDURES . . . . .	13
4.1 Normal Operating Procedure . . . . .	13
4.2 Maintenance of Dam . . . . .	13
4.3 Maintenance of Operating Facilities . . . . .	13
4.4 Warning Systems in Effect . . . . .	13
4.5 Evaluation . . . . .	13
SECTION 5 - HYDROLOGIC/HYDRAULIC EVALUATION . . . . .	14
5.1 Design Data . . . . .	14
5.2 Experience Data . . . . .	14
5.3 Visual Observations . . . . .	15
5.4 Overtopping Potential . . . . .	15
5.5 Spillway Adequacy . . . . .	15
SECTION 6 - EVALUATION OF STRUCTURAL INTEGRITY . . . . .	17
6.1 Visual Observations . . . . .	17
6.2 Design and Construction Techniques . . . . .	18
6.3 Past Performance . . . . .	18
6.4 Seismic Stability . . . . .	18

## TABLE OF CONTENTS

	<u>Page</u>
SECTION 7 - ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES . . . . .	19
7.1 Dam Assessment . . . . .	19
7.2 Recommendations/Remedial Measures . . . . .	19
APPENDIX A - CHECK LIST - VISUAL INSPECTION	
APPENDIX B - CHECK LIST - ENGINEERING DATA	
APPENDIX C - HYDRAULICS AND HYDROLOGY CALCULATIONS	
APPENDIX D - PHOTOGRAPHS	
APPENDIX E - GEOLOGY	
APPENDIX F - FIGURES	
APPENDIX G - REGIONAL VICINITY MAP	



PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM  
TWO LICK CREEK DAM  
NDI# PA-285, PENNDER# 32-75

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Two Lick Creek Dam is a combination concrete gravity and earth- rockfill embankment. It is approximately 1,200 feet long with a maximum height of 115 feet. The right side of the structure is a concrete gravity dam with six concrete ogee-shaped overflow spillway bays. The three bays located nearest to the right abutment (defined as Bays 1, 2, and 3 of this report) are uncontrolled and function as the emergency spillway. The three bays located to the left of the emergency spillway (defined as Bays 4, 5, and 6 of this report) are equipped with mechanically operated radial gates. These bays function as the primary spillway with crests 33.5 feet lower than the crests of the emergency spillway. In addition, the facility is equipped with a discharge tunnel (concrete box culvert type) located to the right of the junction between the concrete and earth- rockfill sections of the structure. The left side of the structure is an earth- rockfill embankment which wraps around the left extremity of the concrete dam (see Figure 1, Appendix F).

b. Location. Two Lick Creek Dam is located on Two Lick Creek in White Township, approximately 3 miles south-east of the Borough of Indiana, Pennsylvania. U. S. Route 422 is constructed approximately parallel to the reservoir and is less than 1/2 mile south of the embankment at its closest point. The dam, reservoir, and watershed are contained within Barnesboro, Brush Valley, Clymer, Commodore, Marion Center, Rochester Mills, and Strongstown U.S.G.S. 7.5 minute quadrangles (see Appendix G). The coordinates of the dam are N40° 35' 30" and W79° 6.0' 0".

c. Size Classification. Large (115 feet high, 16,200 acre-feet capacity at design pool elevation 1183).

d. Hazard Classification. High (see Section 3.1.c.5).

e. Ownership. New York State Electric and Gas Corporation, Binghamton, New York. Pennsylvania Electric Company, Johnstown, Pennsylvania.

f. Purpose of Dam. Water supply for the Homer City generating station.

g. Historical Data. The facility was designed by Gilbert Associates, Inc., of Reading, Pennsylvania. Construction began in the spring of 1967 and was completed by December of 1968. The dam was built in conjunction with the Homer City Generating Station. Both facilities are jointly owned by the New York State Electric and Gas Corporation of Binghamton, New York, and the Pennsylvania Electric Company of Johnstown, Pennsylvania. Monthly construction progress reports were prepared by Bechtel Corporation of San Francisco, California, acting as construction managers for the project. These reports indicate the project was completed in general accordance with the preliminary schedule and apparently without a major problem.

In July 1977, a storm caused damage to the right abutment downstream of the emergency spillway. Subsequently, the facility was inspected by Gilbert Associates, Inc., and Penelec personnel. A copy of the report detailing their findings is available from Penelec files.

No PennDER inspection reports have been filed on this facility since construction.

### 1.3 Pertinent Data.

a. Drainage Area. 74 square miles.

b. Discharge at Dam Site. Discharge data is compiled daily at this facility. Conversations with Mr. Gallus of Pennsylvania Electric Company indicate that the maximum flood at this facility occurred on July 20, 1977. An investigation by Gilbert Associates, Inc., subsequent to the flood revealed that maximum high water reached approximately one foot over the emergency spillway (400 cfs). The extent of the opening of each gate is believed to have been approximately two feet. Therefore, the total discharge is estimated to have been 6,000 cfs.

Outlet Works Conduit at Operating Pool Elevation -  
Discharge curve not available.

Primary Spillway Capacity at Maximum Gate Opening  $\approx$   
62,500 cfs (reservoir level at 1183).

c. Elevation (feet above mean sea level).

Top of Dam - 1195.

Maximum Pool Design Surcharge - 1185.

Maximum Pool of Record  $\approx$  1185.5.

Normal Pool - 1183.

Upstream Portal Invert Outlet Conduit - 1107.5.

Downstream Portal Invert Outlet Conduit - 1105.

Streambed at Centerline of Dam  $\approx$  1105.

Maximum Tailwater - Not known.

d. Reservoir Length (miles).

Maximum Design Pool  $\approx$  5.3 (elevation 1185).

Normal Pool  $\approx$  5.0 (elevation 1183).

Top of Dam  $\approx$  6.7 (elevation 1195).

e. Storage (acre-feet).

Maximum Design Pool  $\approx$  17,000 (elevation 1185).

Normal Pool  $\approx$  16,200 (elevation 1183).

Top of Dam  $\approx$  23,000 (elevation 1195).

f. Reservoir Surface (acres).

Maximum Design Pool  $\approx$  525 (elevation 1185).

Normal Pool  $\approx$  510 (elevation 1183).

Top of Dam  $\approx$  650 (elevation 1195).

g. Dam.

Type - Combination concrete gravity and earth-  
rockfill.

Length  $\approx$  1,200 feet.

Height  $\approx$  115 feet.

Top Width - 40 feet.

Side Slopes (earth- rockfill section -  
upstream 1.5H:1V  
downstream 1.5H:1V

Zoning - See Figures 6 and 7, (Appendix F).

Impervious Core - Figures 6 and 7, Appendix F, indicate the embankment is constructed with an impervious central core of varying cross-section.

Cutoff - A cutoff trench was reportedly extended into sound rock. The bottom width of the cutoff trench is 20 feet.

Grout Curtain - Contract drawings indicate a grout curtain in the center of the cutoff trench under the embankment section of the dam and upstream from the concrete gravity and spillway sections of the dam. The design report indicates the grout curtain was extended to a depth of approximately 80 feet across the valley, and into the abutment to a distance and depth sufficient to minimize appreciable water movement (see Figure 5, Appendix F).

#### h. Outlet Conduit.

Type - Contract drawings indicate that the discharge tunnel outlet is a 12-foot high by 14-foot wide concrete box type conduit. The conduit has intakes located at three different elevations along the structure. Flow is controlled by mechanical gates operated from within the structure. Two manually operated emergency gates are located atop the dam crest and enable the conduit to be sealed off so that the mechanical gates can be serviced.

Length  $\approx$  Approximately 420 feet.

Closure - Gate valves at elevations 1165, 1145, and 1125. Manual emergency slide gates are controlled from atop the dam crest.

Access - The gate valves are accessible by chambers through the interior of the structure. The emergency slide gates are directly accessible at the crest.



Regulating Facilities - Gate valves, mechanically operated. A low level release with intake elevation 1107.5 located in the discharge tunnel provides emergency drawdown capabilities. This release is apparently regulated at the downstream end of the discharge tunnel. (see Figure 9, Appendix F).

i. Spillway.

Type (primary) - Three 30-foot wide overflow spillway bays with concrete ogee-shaped weirs. Mechanically operated 30-foot wide by 32-foot high radial gates regulate discharge.

Weir Length - 90 feet.

Crest Elevation - 1151.

Upstream Channel - Not applicable.

Downstream Channel - The primary spillway discharges into a spillway bucket before entering the natural downstream channel. A dike has been constructed to the left of the natural channel to divert flow away from the embankment toe (see Figure 1, Appendix F).

Type (emergency) - Three 34-foot wide ungated overflow spillway bays with concrete ogee-shaped weirs.

Weir Length - 102 feet.

Crest Elevation - 1184.5.

Upstream Channel - Available drawings indicate the emergency spillway bays have individual approach channels cut into rock on the right abutment (see Figure 1, Appendix F).

Downstream Channel - The emergency spillway bays discharge over a rock cliff on the right abutment before entering the natural downstream drainage as shown on Photograph 11, Appendix D.

j. Regulating Outlets. Flow through the concrete box-type discharge tunnel is mechanically regulated with intakes at elevations 1165, 1145, and 1125. In addition, the drawings indicate a low level release conduit which can apparently be utilized to draw down the reservoir.

## SECTION 2 ENGINEERING DATA

### 2.1 Design Data.

#### a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. A report prepared by Gilbert Associates, Inc., entitled, "Report No. 1637, Design of Two Lick Creek Dam, Volume I, Design Report, December 15, 1966," contains a synopsis of the hydrology and hydraulics considered for this project. Included are low flow and flood flow hydrology along with spillway design criteria. The report is available from PennDER files. Design calculations are not included.

2. Embankment. Information available relative to the embankment design includes boring logs, foundation and borrow investigations (Volume II, Design Report), and a soils report (Volume III, Design Report). In addition, Volume I of the design report (see 1 above) includes a synopsis of the overall embankment design. Results of the stability analysis are shown on Figure 7 (see Appendix F). This information is available from the Pennsylvania Electric Company, Johnstown, Pennsylvania.

3. Appurtenant Structures. The only design information available pertaining to the appurtenant structures of the facility is contained within Volume I of the design report (see 1 above). No design calculations were obtained.

#### b. Design Features.

1. Embankment. Design drawings indicate the left side of the embankment is a zoned earth-rockfill structure. It is constructed on a 1.5H on 1V upstream slope and a 1.5H on 1V downstream slope. The outer slopes are composed of riprap and quarry run rockfill. Two 15-foot berms are provided on both the upstream and downstream slopes of the embankment. A sand filter layer is provided immediately beneath the outer rock layers. The filter zones bound the random rolled fill zone on the upstream side of the embankment and the impervious core on the downstream side of the embankment and the impervious core on the upstream side of the structure (see Figure 6, Appendix F).

A 20-foot wide (bottom width) cutoff trench was excavated beneath the impervious core. A grout cap forms the bottom of the cutoff trench beneath the embankment section. The grout curtain is approximately 80 feet deep and extends into the abutments.

The concrete non-overflow portion of the dam consists of Blocks 1, 2, 10, 11, 12, and 13. The minimum top width is 12 feet and the back slope is 0.7 on 1.0 (see Figure 9, Appendix F).

Typically, the concrete section, including the spillway, has a 4.5-foot wide drainage and inspection gallery with a floor elevation of 1130 and a top elevation of 1138. An 18-inch wide gutter, of varying depth is provided at the upstream face of the gallery. Uplift relief drains discharge into this gutter.

Blocks 1 and 2 are straight sections, 12 feet wide, which are primarily abutment connection blocks.

Block 10 has a design height of 68 feet, with a 12-foot top width and with the standard 0.7H on 1V back slope.

Block 11 has a design height of 75 feet, with a nominal top width of 18 feet. A 5-foot wide cantilevered deck is provided upstream of access and installation space for the slide gate hoists. In addition to the drainage and inspection gallery, Block 11 contains access galleries to each of the two higher level water release valves, discharge galleries of the water control system and a stairway connecting the lower level valve access gallery with the inspection and drainage gallery.

Block 12 has a design height of 95 feet, with a top width of 15 feet. The control building is located on the downstream face of Block 12. Block 12 contains the discharge tunnel. The lower 20 feet of this block lies within a trench excavated into sound rock and is restrained on three sides. The lower level water release valves, the low level control room, the discharge gallery, stairs connecting the upper and lower valve access galleries, and an access gallery into the control building are located in Block 12. Sump dewatering is also done from Block 12.

Block 13 has a design height of 90 feet, with a top width of 12 feet. A 6-foot equipment shaft is provided in Block 13 from the top of the dam to the inspection and drainage gallery. Exterior mounted stairs run down the back faces of Blocks 12 and 13 from the top of the dam to the control building. The primary point of design interest of Block 13 is that the impervious fill of the adjoining embankment wraps around the upstream and downstream faces to form a complete water barrier. All faces of Block 13, except where it adjoins Block 12, form a sloped surface for contact with earth.



## 2. Appurtenant Structures.

a) Primary Spillway. The primary spillway (Bays 4, 5, and 6) was designed with 30-foot wide bays and a crest at elevation 1151. Control is provided by three motor-operated radial gates (see Figures 9, 10, and 11, Appendix F).

b) Emergency Spillway. The emergency spillway (Bays 1, 2, and 3) was designed to be an uncontrolled discharge outlet. The three bays are equipped with concrete ogee-shaped weirs with crest elevations at 1184.5 (see Figure 9, Appendix F).

c) Outlet Conduit. The discharge tunnel outlet is a 12-foot high by 18-foot wide concrete box-type conduit. It is equipped with intakes at three different elevations. These intakes form what is known as the water control system at the facility.

d) Water Control System. The controlled water release system, to furnish make-up water to the power station cooling towers, is located in Blocks 11 and 12. Three individual motor control releases are provided, each at a different elevation, in order to take advantage of differences in chemical quality at different depths in the reservoir. The releases are located at elevation 1165, elevation 1145, and elevation 1125. An emergency, manual release (low level outlet) is located at elevation 1107.5 (see Figure 9, Appendix F, and Section 1.3.J).

### c. Design Data.

1. Hydrology and Hydraulics. (see Section 5.1).

2. Embankment. The determining factors in design of the embankment section were availability of materials, and foundation conditions. The design was based on the geologic conditions (Vol. II of the design report) and the laboratory results of the subsurface exploration program (Vol. III of the design report).

Slope stability was performed with an IBM 1620 computer program, utilizing a modified Swedish circle method. Full consideration for saturated and submerged conditions are written into the program. The results obtained by this method are conservative. Nominal factors of safety were the desired results, since conservative soil strengths and method of analysis were used. For final analysis, 24 complete cases were run, many with varying strengths of earth-fill. The results are shown on Figure 7, Appendix F, and are representative of the minimum factors of safety obtained.



The stability of various sections of the concrete structure were analyzed separately. The results are shown on Figure 4, Appendix F.

## 2.2 Construction Records.

Construction records including weekly status reports, photographs, and memoranda are available in PennDER files.

## 2.3 Operational Records.

The daily operation of the facility is monitored and recorded continuously at the control room located on the downstream face of Block 12.

## 2.4 Other Investigations.

Following the flood of July 20, 1977, both the Pennsylvania Electric Company and Gilbert Associates, Inc., conducted separate investigations to review the extent of damage to the facility and its appurtenances. The results of the investigations are available from the Pennsylvania Electric Company.

## 2.5 Evaluation.

Engineering data were provided by the Pennsylvania Department of Environmental Resources (PennDER) and the Pennsylvania Electric Company. Sufficient data are available to indicate the structure was formally engineered in accordance with accepted modern engineering practice.

## SECTION 3 VISUAL INSPECTION

### 3.1 Observations.

a. General. The general appearance of this project indicates the dam and its appurtenances are currently in good condition. The features which have been incorporated into its design further indicate that the facility was formally engineered in accordance with modern practice.

b. Embankment.

1. Earth- Rockfill Section. The earthen portion of the embankment is in fair condition. No seepage is evident through the embankment or abutments. The embankment is well aligned and no appreciable crest settlement was detected at the time of inspection. Three deficiencies were noted: 1) The upstream and downstream slopes are heavily overgrown. Sizeable trees (6-inch diameter) whose growth have apparently remained unchecked for a number of years are visible over the entire embankment (see Photograph 2, Appendix D); 2) The riprap and quarry run rockfill placed on both the upstream and downstream slopes may be less resistant than intended although specifications were not available which would permit an accurate evaluation of its suitability (see Photograph 9, Appendix D); and 3) The entire length of the earth embankment toe is submerged by a standing pool of water (see Photograph 10, Appendix D). The somewhat triangular shaped pool is impounded by the embankment, the left abutment, and an earth dike located parallel to the discharge channel. Available design drawings reviewed prior to the inspection indicate a 24-inch diameter drain pipe is located through the downstream end of the earth dike. The pipe was not located by the inspection team. Furthermore, the owner apparently has no knowledge of its existence. It was assumed that this pipe is either clogged or non-existent.

2. Non-Overflow Concrete Section. The non-overflow portion of the concrete gravity embankment is in good condition. Several isolated areas of minor cracking and spalling are visible upon close inspection but these are not considered significant. The control room and interior inspection galleries are in good condition. These areas are well maintained. Some condensation is visible on the gallery ceilings and efflorescence is visible at construction joints in several areas. With the exception of one gate valve currently under repair, the operating mechanisms and monitoring systems appear to be in excellent condition. Similarly, the mechanical winch system located atop the crest also appears to be in working order although it was not operated in our presence.

c. Appurtenant Structures.

1. Primary Spillway. The primary spillway bays (Bays 4, 5, and 6) are in good condition. The three radial gates were in a fully closed position during the inspection and were not operated in the presence of the inspection team. A small amount of water was issuing from Bays 5 and 6 indicating an imperfect seal between the spillway gates and wingwall. The mechanical system, including the gates and winches, appeared to be in good condition and are reported to be in proper operating order. Minor spalling and scaling were visible on the surfaces of the ogee-shaped weirs, particularly at the construction joints. The spillway apron is deteriorated in some areas, possibly due to etching action acidic outflow associated with mine drainage.

2. Emergency Spillway. The emergency spillway bays (Bays 1, 2, and 3) are in excellent condition. No signs of concrete deterioration or discoloration were visible. The emergency spillway bays have reportedly discharged only once; during the area flood of July 20, 1977.

3. Outlet Conduit. The outlet conduit appeared to be functioning properly during the inspection. The majority of the conduit is not accessible for inspection; consequently, its overall condition was not ascertainable. The only portion visible to the inspection team was the discharge end. At this point, flow through the conduit is automatically measured and recorded in the control room.

4. Reservoir Area. The general area surrounding the reservoir is characterized by moderate to steep slopes. The area is primarily wooded although a few isolated cleared sections are visible along the shore (see Photograph 5, Appendix D).

5. Downstream Channel. The downstream area considered in this section extends left from the emergency spillway bays at the right abutment to the channel immediately beyond the discharge end of the outlet conduit. For the most part, the downstream channel is in good condition. The channel floor is predominantly a durable sandstone. What appears to be to an excess of loose rocks and boulders are scattered over the downstream area (see Photograph 1, Appendix D). At the present time, however, flow does not appear to be obstructed. It is noted that revised Drawing C-726-412, Exhibit 16, by Gilbert Associates, Inc., (see Figure 8, Appendix F) shows an earth dike (top elevation 1125.0) across the downstream channel perpendicular to the flow located at a point approximately 50 yards beyond the spillway crests. The owner's representative indicated that the dike depicted in this drawing was a temporary structure that was removed prior to project completion.

The portion of the downstream channel which is not in good condition is that area immediately beyond the emergency spillway (Bays 1, 2, and 3). Significant erosional damage occurred as a result of the July 1977, flood (see Photographs 11 and 12, Appendix D). The area, nevertheless, appears sound in spite of the damage. All concrete sections of the embankment remained intact.

A small water works serving Indiana, Pennsylvania, is located approximately 1-1/2 miles downstream of the dam. The facility is situated on the Two Lick Creek floodplain and is undoubtedly in an area that would be affected by a breach of the dam. The communities of Upper Two Lick and Homer City located 3-1/2 and 8 miles, respectively, downstream of the dam contain residences that could easily be affected by a breach of the dam. A conservative estimate of the number of persons that reside within the influence of the flood waters from Two Lick Creek Dam would exceed 100.

Because of the above mentioned considerations the facility was given a "high" hazard rating.

### 3.2 Evaluation.

The facility has several deficiencies which require attention. These deficiencies include overgrowth of the embankment, apparent poor quality riprap and rockfill, lack of proper drainage at the toe, and an erosion problem downstream of the emergency spillway.

It must be noted that the owner is knowledgeable of the overall condition of the facility and that some of the above mentioned items were scheduled for remedial service prior to our inspection.



## SECTION 4 OPERATIONAL PROCEDURES

### 4.1 Normal Operational Procedures.

According to the owner's representative, the spillway gates at the facility are operated in accordance with the operational procedure presented in Volume I of the design report. However, the system is no longer automatic as originally designed and is now manually operated by on-site personnel.

The water control system, which regulates flow through the discharge tunnel, is reported to be operated remotely from the generating station.

A dam caretaker is on hand at the facility on a 7-day a week, 24-hour a day basis.

### 4.2 Maintenance of Dam.

The dam has been reportedly maintained on an as-needed basis. The recent advent of a full-time staff has apparently upgraded the maintenance program. In addition, discussions with the owner's representative indicate that remedial maintenance work is scheduled to begin prior to September 1, 1978.

### 4.3 Maintenance of Operating Facilities.

No formal schedule or manual is available detailing required maintenance of the facility.

### 4.4 Warning Systems.

There are no formal warning systems in effect.

### 4.5 Evaluation.

The operational procedures at the facility appear to be clear and well defined. No formal maintenance program is currently in effect. Extensive remedial work is reportedly scheduled to commence prior to September 1, 1978.

## SECTION 5 HYDROLOGIC/HYDRAULIC EVALUATION

### 5.1 Design Data.

The criteria considered in the hydrology and hydraulic evaluation of this project are summarized in a report by Gilbert Associates, Inc., entitled "Report No. 1637, Design of Two Lick Creek Dam" (Volume I, Design Report, December 15, 1966). The main points included in the report are presented below.

The purpose of the facility, as previously stated, is to supply sufficient amounts of water to meet the requirements of the Homer City Generating Station. The required reservoir capacity, as determined from the plant and downstream make up requirements, is 16,200 acre-feet at full pool (elevation 1183). The required reservoir capacity coupled with upstream flooding considerations at the town of Clymer, established the maximum flood pool level to be at elevation 1185.

By use of the Hydrometeorological Report No. 33 and Technical Paper No. 40 (both by the United States Weather Bureau), a "Maximum Probable Storm" was determined for the drainage area of Two Lick Creek Dam. Probable storms for recurrence intervals of 10 years, 25 years, 100 years, and 1,000 years were also determined. Design flood peaks were computed by various empirical formulas and by unitgraph. For the unitgraph flood, a "Maximum Probable Storm" was assumed which produced a rainfall of 26 inches, over the entire drainage basin, in a period of 24 hours, with 14 inches of rainfall occurring the first 3 hours and producing 12.5 inches of runoff. Such a storm produced a flood peak of 66,100 cfs.

Considering the above requirements in combination, it was determined that a gated spillway section was necessary. The spillway was designed with three 30-foot wide bays, with crests at elevation 1151. The spillway capacity, with gates fully open and reservoir level at elevation 1183, is 62,500 cfs. To pass a flood peak of 66,100, the reservoir level is at elevation 1184.2. Additional flood discharge capacity is provided by the emergency spillway whose crest elevation is set at 1184.5, while the top of dam is set at elevation 1195. The capacity of the emergency spillway is approximately 10,500 cfs.

### 5.2 Experience Data.

Reservoir levels and low flow discharge are monitored on a continuous basis at the facility. The records indicate

the facility has performed adequately in the past. During the flood of July 1977, the emergency spillway inadvertently discharged causing the damage to the right abutment which is visible today. The situation occurred because the automatic radial gate mechanism was wired to shut down when the gate opened two feet. Consequently, the water in the reservoir steadily rose until it discharged through the emergency spillway. The mechanism has since been repaired and the limiting device removed. The gates have been tested and reportedly are capable of opening fully.

### 5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate the appurtenant structures of the dam could not operate satisfactorily during a flood event.

### 5.4 Overtopping Potential.

The ratio "PMF Peak Flow/Drainage Area" was determined from an empirical curve supplied by the Corps of Engineers, Baltimore District. The curve used was the Ohio River Basin curve. Based on this curve and a drainage area of 74 square miles, Peak PMF  $Q/A = 760$  cfs/sq. mi., and Peak PMF  $Q = 56,240$  cfs. The size category is "large" and the hazard rating "high". Consequently, the SDF is the PMF.

Calculations were performed to evaluate the overtopping potential using spillway and storage capacities during the PMF.

The discharge capacity of the primary spillway was considered with the reservoir level set at elevation 1183. This corresponds to the top elevation of the maximum opening of the radial gates. When the reservoir level is at or below this elevation, discharge will be solely through the primary spillway. With all three radial gates open full, the primary spillway discharge is equal to 62,560 cfs. A comparison of Peak PMF  $Q$  (56,240 cfs) with primary spillway discharge (62,560 cfs) indicates the primary spillway discharge is greater than the peak inflow.

### 5.5 Spillway Adequacy.

The spillway and dam are capable of passing and/or containing the runoff resulting from a storm of PMF magnitude. This is accomplished solely by the primary spillway (Bays 4, 5, and 6) and without the additional discharge capacity available from the emergency spillway (Bays 1, 2, and 3).

As a result, the spillway system is deemed adequate assuming proper operation of the radial gate system.



SECTION 6  
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment.

1. Earth- Rockfill Section. The visual inspection revealed this area to possess the most serious deficiencies associated with the facility. These are, as discussed in Section 3.1.b.1, the overgrown slopes, the apparent poor quality riprap and quarry run fill, and the lack of adequate drainage at the toe. Project specifications were not available; consequently, the design requirements for the riprap and quarry run rock are not known. Nevertheless, there is considerable slaking of the riprap on the upstream face as well as the quarry run rockfill on the downstream slope. The owner is currently considering alternate solutions to the riprap problem. It is not known if the random rock beneath the surface is also degraded which would affect the need for necessary immediate remedial action.

As for the overgrowth, the owner is aware of the problem and reportedly plans to remove the trees before winter. The water at the toe of the dam is apparently the result of surface runoff being impounded by the earth dike that parallels the stream channel. Periodically, the water reportedly evaporates, temporarily drying the area.

Presently, the above conditions are considered undesirable but do not appear to present an immediate threat to the stability of the structure.

2. Non-Overflow Concrete Section. Based on the visual inspection, this portion of the facility appears to be well designed, stable, and presently in good condition.

b. Appurtenant Structures. The appurtenances of this facility, including both the primary and emergency spillway, and the low discharge tunnel, appear to be in good condition. A complete evaluation of their overall structural integrity is not possible without first hand observation of the associated mechanisms in operation. However, based on the general appearance of the appurtenances, no structural deficiencies are apparent. The July 1977, flood caused significant damage to the area just downstream of the emergency spillway. Conversations with the owner's representative indicates that provisions to repair the damage are presently under consideration and that corrective work should commence by September 1978.

## 6.2 Design and Construction Techniques.

The design reports and information received from PennDER and the Pennsylvania Electric Company indicate the facility has been adequately designed in conformance with accepted modern engineering practice. Additional information in the form of "revised" design drawings, construction photographs, and reports reinforce our opinion that the structure is stable in both concept and construction.

## 6.3 Past Performance.

The facility has survived the storm which resulted in the Johnstown flood on July 1977. Available records indicate the facility performed as designed throughout its short history.

## 6.4 Seismic Stability.

The dam is located within Seismic Zone No. 1 and it is thought that the static stability is sufficient to withstand minor earthquake induced dynamic forces. However, no calculations, investigations, etc., were performed to confirm this opinion.

SECTION 7  
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection, operational history, and available engineering data suggest that certain conditions at the facility require further study while others require immediate attention. Conversations with the owner's representative indicate that the owner is knowledgeable of the deficiencies at the facility. Furthermore, the owner appears to possess a positive attitude relative to their resolution. The overall condition of the facility is considered good.

Hydraulic and hydrologic calculations indicate that the spillway is capable of passing and/or storing the flow resulting from a storm of PMF intensity and consequently the spillway capacity can be considered adequate.

b. Adequacy of Information. The available data are considered sufficient to make an accurate assessment of the facility.

c. Urgency. It is suggested that the recommendations listed below be implemented immediately.

d. Necessity for Additional Investigations. An investigation (refer to Section 7.2) of the durability and/or suitability of the riprap and quarry run rockfill is considered necessary.

7.2 Recommendations/Remedial Measures.

It is recommended that:

a. The owner investigate the physical characteristics of the riprap and quarry run rockfill. Conclusions relative to its suitability should be developed and remedial action implemented, if necessary.

b. Positive drainage be provided to eliminate the ponding condition along the downstream toe of the earth-rockfill portion of the embankment.

c. The owner immediately remove the overgrowth visible on both sides of the earth-rockfill embankment.

d. The owner implement remedial measures to repair damage to the right abutment (emergency spillway outlet).

e. The owner formalize a regular maintenance program.

f. The owner develop a warning system that will provide for the safe evacuation of all downstream inhabitants in the event of an inordinantly heavy rainfall.

g. The facility be inspected on a periodic basis by a registered professional engineer to check for deleterious conditions which might develop.



APPENDIX A

CHECK LIST - ENGINEERING DATA

ITEM	CHECK LIST		NAME OF DAM		Two Lick Creek Dam	
	ENGINEERING DATA		ID #		NDI # PA-285 Penndder 32-75	
	DESIGN, CONSTRUCTION, OPERATION		PHASE I			
	REMARKS				SHEET 1	

#### AS-BUILT DRAWINGS

Specific "as-built" drawings are not available. Design drawings are available in the Appendix of the design report, Volume I entitled "Report No. 1637, Design of Two Lick Creek Dam". The report is available from both Penelec and PennDER.

#### REGIONAL VICINITY MAP

See Appendix G.

#### CONSTRUCTION HISTORY

Construction status report, memoranda, and photographs are available from PennDER.

#### TYPICAL SECTIONS OF DAM

See Figures 6, 7, 9, 10, and 1 in Appendix F.

#### OUTLETS - PLAN See Figure 3 in Appendix F.

- DETAILS See Figures 9, 10, and 1 in Appendix F.

- DISCHARGE RATINGS See Figure 2 in Appendix F.

#### RAINFALL/RESERVOIR RECORDS

Reservoir levels are monitored continuously and recorded at the facility. Rainfall records are compiled at the Homer City Generating Station. Reports are available from Penelec.

ITEM	REMARKS	ID #	SHEET 2
DESIGN REPORTS			
	"Report No. 1637, Design of Two Lick Creek Dam": Volumes I, II, and III by Gilbert Associates, Inc. are available from PENNDR.		
GEOLOGY REPORTS			
	Contained within design report Volume II. The report is subtitled "Foundation and Borrow Investigation."		
DESIGN COMPUTATIONS			
HYDROLOGY & HYDRAULICS	A summary of the hydrology and hydraulic design criteria are contained within design report, Volume I.		
DAM STABILITY			
SEEPAGE STUDIES			
MATERIALS INVESTIGATIONS			
BORING RECORDS	Contained within all three design report volumes.		
LABORATORY			
FIELD			
POST-CONSTRUCTION SURVEYS OF DAM			
	None		
BORROW SOURCES			
	Discussed in design report Volume II and depicted on one of the design drawings contained in the appendix of design report Volume I.		

ITEM	REMARKS	ID #	SHEET 3
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#### MONITORING SYSTEMS

The entire operation of the facility is continuously monitored and recorded. System records are available from PennDER.

#### MODIFICATIONS

Following the flood of July, 1977, the automatic spillway gate system was modified such that the system is now controlled manually.

#### HIGH POOL RECORDS

Available from PennDER. The highest pool of record occurred July 20, 1977. At this time the reservoir level was measured to be at approximate elevation 1185.5 or one foot over the emergency spillway.

#### POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS

Seperate investigations were performed by Penelec and Gilbert Associates, Inc., following the flood of July, 1977. The investigations pertained to the damage incurred as a result of flood waters. Results of the investigations are available from Penelec.

#### PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS

See "Post Construction Engineering Studies and Reports" above.

#### MAINTENANCE OPERATION RECORDS

Available from Penelec.



ITEM	REMARKS	ID #	SHEET 4
------	---------	------	---------

SPILLWAY PLAN See Figures 1, 3, and 8, Appendix F.

SECTIONS See Figure 9, Appendix F.

DETAILS See Figure 1, Appendix F.

OPERATING EQUIPMENT  
PLANS & DETAILS

See Figures 10 and 11, Appendix F.

NDI# PA-285  
ID # PennDER 32-75

CHECK LIST      ID #  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 74 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1183 (16,200 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1184.5 (16,700 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 1185 (17,000 acre-feet)

ELEVATION TOP DAM: 1195 (23,000 acre-feet)

SPILLWAY DATA:

- a. Crest Elevation (primary) 1151; (emergency) 1184.5
- b. Type (primary and emergency) concrete ogee-shaped weirs
- c. Weir Length (primary) 90 feet; (emergency) 102 feet
- d. Channel Length Not applicable.
- e. Location Spillover right abutment
- f. Number and Type of Gates 3 mechanical radial tainter gates

OUTLET WORKS:

- a. Type 12 by 14 foot concrete box-culvert
- b. Location junction of the earth embankment with the concrete
- c. Entrance gravity dam 1107.5
- d. Exit Inverts 1105
- e. Emergency Draindown Facilities low level release (see Figure 9)

HYDROMETEOROLOGICAL GAGES:

- a. Type Rain gage
- b. Location Homer City Generating Station
- c. Records daily records available from Penelec

MAXIMUM NON-DAMAGING DISCHARGE: Specific data not available.

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST  
VISUAL INSPECTION  
PHASE 1

DAM NAME Two Lick Creek Dam COUNTY Indiana STATE PA NDI# PA-285  
ID # PennDER 32-75

TYPE OF DAM Concrete & earth- and rockfill HAZARD CATEGORY high

DATE(S) INSPECTION 8/11/78 WEATHER Hazy & warm TEMPERATURE 73°

POOL ELEVATION AT TIME OF INSPECTION 1176.8 M.S.L.

TAILWATER AT TIME OF INSPECTION None at M.S.L.  
gates, low flow  
in stream through  
outflow.

INSPECTION PERSONNEL:

B. M. Mihalcin (GAI) R. Gallus (Penelec)

J. P. Nairn (GAI)

D. L. Bonk (GAI)

D. L. Bonk RECORDER



## VISUAL EXAMINATION OF

## OBSERVATIONS

## SURFACE CRACKS

None observed.

UNUSUAL MOVEMENT OR  
CRACKING AT OR BEYOND  
THE TOE

None observed. The downstream toe was partially submerged by a pool of water, 1 foot to 3 feet deep, between the toe and discharge channel dike.

SLOUGHING OR EROSION OF  
EMBANKMENT AND ABUTMENT  
SLOPES

Rock disintegration is profuse across both the upstream and downstream slopes. Many trees have accumulated on the dam slopes.

VERTICAL AND HORIZONTAL  
ALIGNMENT OF THE CREST

Good.

## RIPRAP FAILURES

Much of the riprap and rockfill zone on the upstream slope has deteriorated and appears to be composed primarily of non-durable siltstones and silty shales.

CONCRETE/MASONRY DAMS

ID # PA-285

SHEET 1

VISUAL EXAMINATION OF

ANY NOTICEABLE SEEPAGE

None observed.

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

STRUCTURE TO  
ABUTMENT/EMBANKMENT  
JUNCTIONS

Excellent condition.

DRAINS

Relief drains are visible throughout the concrete section of the structure.

WATER PASSAGES

Outflow structure open. Monitoring weir located at the discharge end was flowing full during the inspection.

FOUNDATION

Not observed. Structure is founded on rock. A grout curtain has been provided beneath the dam.

EMBANKMENT

ID #

PA-285

SHEET 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.	
ANY NOTICEABLE SEEPAGE	No visible seepage along the downstream face. The downstream toe is completed inundated by approximately 1 to 3 feet of water.	
STAFF GAGE AND RECORDER	A staff gage is attached to the upstream face of the concrete portion of the structure. It is located to the left of Bay 6 (spillway bay furthest from the right abutment) and to the right of the discharge conduit intakes.	
DRAINS	No drains were observed through the earth portion of the embankment.	

JUNCTION OF EMBANKMENT  
AND ABUTMENT, SPILLWAY  
AND DAM

Good condition.

ANY NOTICEABLE SEEPAGE

No visible seepage along the downstream face. The downstream toe is completed inundated by approximately 1 to 3 feet of water.

STAFF GAGE AND RECORDER

A staff gage is attached to the upstream face of the concrete portion of the structure. It is located to the left of Bay 6 (spillway bay furthest from the right abutment) and to the right of the discharge conduit intakes.

DRAINS

No drains were observed through the earth portion of the embankment.

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Minor cracking and some slight spalling and scaling were visible on the crest and the main spillway bays. Extensive scaling is visible on the primary spillway apron.	
STRUCTURAL CRACKING	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT	Good.	
MONOLITH JOINTS	Good.	
CONSTRUCTION JOINTS	Good condition. No separation or deterioration observed.	
STAFF GAGE OR RECORDER:	See embankment.	



VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Concrete surfaces appear to be in good condition. Much of the concrete displays a reddish-orange tint. This is likely to be due to the acidic nature of the water in the reservoir. Deep coal mines are present in the general area and consequently, acid mine drainage is likely to be prevalent.	
INTAKE STRUCTURE	Intakes were submerged during the inspection. Gate valves and gate controls were observed from within the structure via several access chambers. One of the gate valves was in the process of being repaired while the rest of the equipment appeared to be in good condition. None of the equipment was operated in the presence of the inspection team.	
OUTLET STRUCTURE	Good condition. Reddish-orange tinted concrete is visible at and below the flow line. Stainless steel, flow monitoring weir at the discharge end appears to be in good condition. Flow is monitored from the control room situated below the crest and on the left downstream face of the concrete portion of the facility.	
OUTLET CHANNEL	Good condition. The base of the channel appears to be sound bedrock.	
EMERGENCY GATE	The dam is provided with a reservoir drawdown system that is apparently controlled with gates located at the discharge end of the discharge tunnel.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	<p>Six spillway bays with ogee-shaped weirs. Bays 4, 5, and 6 (left to right) are the main discharge outlets and are controlled by mechanically operated radial gates. The operating mechanisms are located atop the dam crest and directly above their respective bays. Bays 4, 5, and 6 are 30 feet by 32 feet. Bays 1, 2, and 3 are for emergency use only and are uncontrolled. Bays 1, 2, and 3 are 34 feet wide by 7 feet high. None of the bays were discharging during the inspection.</p>	
APPROACH CHANNEL	<p>The drawings indicate Bays 1, 2, and 3 to have individual approach channels cut into rock along the right abutment. The channels were submerged and only the channel for Bay 1, which appears to be the most shallow could be observed. It was submerged by approximately 2 feet of water and appears to be in good condition.</p>	
DISCHARGE CHANNEL	<p>Bays 1, 2, and 3 have no well defined discharge channels and merely discharge flow onto the right abutment hillside. The rains which caused the Johnstown Flood of 1977 caused Bays 1, 2, and 3 to discharge. The result was extensive damage to the area immediately beyond the spillway bays. Much of the rock was stripped away by the flood waters.</p>	
BRIDGE AND PIERS	<p>The dam crest is designed to be used as a serviceway which spans all 6 spillway bays. The elevation of the underside of the serviceway is 1191.36 while the elevation of the top of dam is 1195.</p>	

VISUAL EXAMINATION OF		REMARKS OR RECOMMENDATIONS
OBSERVATIONS		
CONCRETE SILL		
Ogee-shaped weir.		
APPROACH CHANNEL		
Submerged during inspection. Available drawings do not indicate a clearly defined approach channel for Bays 4, 5, and 6 as is the case for Bays 1, 2, and 3. The drawings do indicate the depth behind the spillway crest to be 21 feet.		
DISCHARGE CHANNEL		
Main Bays 4, 5, and 6 discharge into a natural channel cut out of rock immediately downstream. A 10-foot dike has been constructed along the left side of the channel to divert flow away from the toe of the earth portion of the embankment. Some large boulders partially obstruct flow and are the likely result of damage caused by the flood of 1977.		
BRIDGE AND PIERS		
See ungated spillway.		
GATES AND OPERATION EQUIPMENT		
Mechanically operated radial spillway gates are manually controlled from atop the crest. Gates for the discharge conduit are also operated from the crest. All other operating mechanisms are controlled from within the interior of the structure.		

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	Stainless steel monitoring weir is located at the discharge end of the discharge tunnel. Another weir located at a small dam downstream measures stream flow. Flow from both weirs is recorded at the operations room located on the downstream face to the left of Bay 6.	
PIEZOMETERS	Several piezometers are visible at various locations and elevations across the downstream face. They reportedly will be read and recorded on a periodic basis by a private consultant. No formal monitoring program now exists.	
OTHERS	The operations room appears to contain the majority of the instrumentation associated with this facility. It is accessible by a stairway from the crest located along the left downstream face of the concrete portion of the structure.	



RESERVOIR

ID # PA-285

SHEET 7

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SLOPES

Generally moderate to steep adjoining hillsides. The majority of the area is heavily wooded with the exception of a few small grassy areas.

SEDIMENTATION

None observed.

## VISUAL EXAMINATION OF

## OBSERVATIONS

## CONDITION

(OBSTRUCTIONS,  
DEBRIS, ETC.)

See "discharge channel, gated and ungated spillways" (Sheets 4 and 5)

## SLOPES

Moderate to steep and heavily wooded on left. Moderately sloped and grassy floodplain on right.

APPROXIMATE NO.  
OF HOMES AND  
POPULATION

Waterworks facilities are located on the floodplain approximately 1-1/2 miles downstream. Homer City, located ~ 8 miles downstream is also likely to experience significant damage in the event of a breach. Total population affected easily exceeds 100.

APPENDIX C  
HYDRAULICS/HYDROLOGY

SUBJECT DAM SAFETY INSPECTION

TWO LICK CREEK DAM

BY DLK

DATE 8-9-78

PROJ. NO. 7E-501-285

CHKD. BY EJM

DATE 8-25-78

SHEET NO. 1 OF 3



Engineers • Geologists • Planners  
Environmental Specialists

### DAM STATISTICS

MAXIMUM HEIGHT OF DAM = 115 FEET (REF 1: pg 3)

DRAINAGE AREA = 74 sq. mi. ( " pg 2 )

STORAGE CAPACITY = 16,200 AC-FT ( " pgs 2 & 3 )  
@ EL 1183

### SIZE CLASSIFICATION

DAM SIZE - LARGE (REF 2: TABLE 1)

HAZARD RATING - HIGH (POSSIBLE LOSS OF LIFE > 3)

REQUIRED SDF = PMF (REF 2: TABLE 3)

### REFERENCES

- 1: "DESIGN OF TWO LICK CREEK DAM", VOLUME I, DESIGN REPORT, GILBERT ASSOCIATES, INC., DECEMBER 15, 1966
- 2: "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS" DEPT. OF THE ARMY - OFFICE OF CHIEF ENGINEER, APPENDIX D
- 3: STANDARD HANDBOOK FOR CIVIL ENGINEERS  
F.S. MERRITT, MCGRAW-HILL 1976

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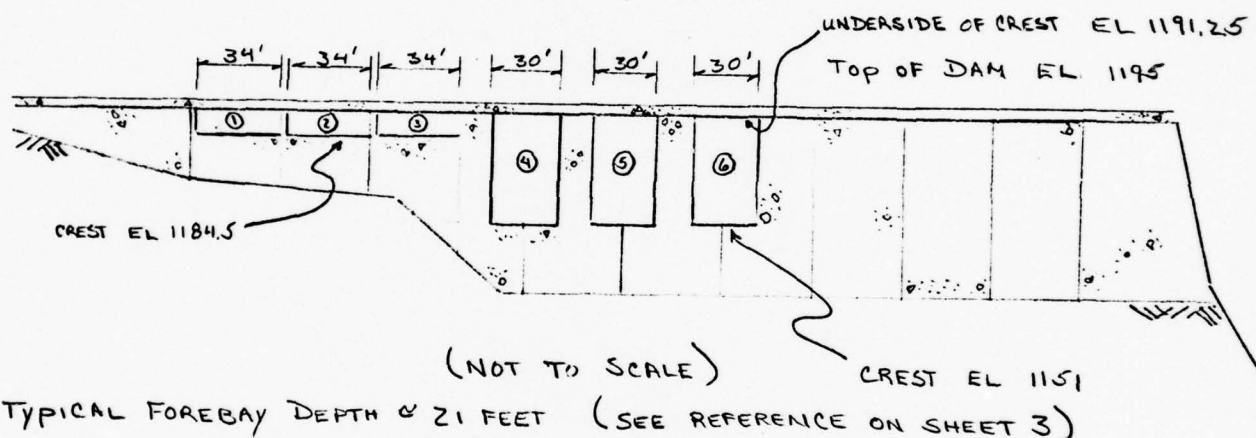


SUBJECT DAM SAFETY INSPECTION  
TWO LICK CREEK DAM  
 BY DLB DATE 8-9-78 PROJ. NO. 78-501-285  
 CHKD. BY EJM DATE 8-25-78 SHEET NO. 2 OF 3

**gai**  
 CONSULTANTS, INC.  
 Engineers • Geologists • Planners  
 Environmental Specialists

PMF (PEAK FLOW)/AREA = 760 CFS/SQ. MI. (REF: C OF E CURVE,  
 OHIO RIVER BASIN)  
 PEAK INFLOW  $Q = (760 \text{ CFS/SQ. MI}) (74 \text{ SQ. MI}) = 56,240 \text{ CFS}$

### SPILLWAY CAPACITY



NOTE: ALL ELEVATIONS ARE EXTRACTED FROM DRAWG C-726-422 "CONCRETE; GENERAL SECTIONS". DIMENSIONS ARE FROM DRAWG C-726-458 by GILBERT ASSOCIATES, INC. OF READING, PENNSYLVANIA, EXCEPT FOR THE WIDTHS OF SPILLWAY BAYS 1, 2, & 3 WHICH WERE MEASURED IN THE FIELD (REVISION II)

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SUBJECT DAM SAFETY INSPECTION  
TWO LICK CREEK DAM  
BY DLB DATE 8-14-78 PROJ. NO. 78-501-285  
CHKD. BY EIM DATE 8-25-78 SHEET NO. 3 OF 3



$Q_1 = 3CL_1H_1^{3/2}$  = DISCHARGE OF SPILLWAY BAYS 4, 5 & 6 (REF 3, EQ 21-121)

$L_1 = 30 \text{ FT}$  (SHEET 2)

$H_1 = 32 \text{ FT}$

(FROM FIG 21-67, REF. 3)

$P/H_1 = 21/32 = 0.66$

NOTE:  $P = 21 \text{ FT}$ , IS THE FOREBAY  
DEPTH SHOWN ON DRAWG C-726-422

$\therefore C = 3.84$

$Q_1 = (3)(3.84)(30 \text{ FT})(32 \text{ FT})^{3/2} = 62,560 \text{ CFS}$

MAXIMUM PRIMARY SPILLWAY DISCHARGE (62,560 CFS) > . . .

. . . > PMF PEAK INFLOW  $Q$  (56,240 CFS)

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APPENDIX D  
PHOTOGRAPHS

PHOTOGRAPH 1 View of Two Lick Creek Dam taken from a point approximately 500 feet downstream. A portion of the left side of the embankment is not visible on the photograph.

PHOTOGRAPH 2 View of the earth portion of Two Lick Creek Dam taken from downstream of the right abutment.

PHOTOGRAPH 3 View of the crest of Two Lick Creek Dam taken from the left abutment.

PHOTOGRAPH 4 View of the upstream face of Two Lick Creek Dam.





1



2



3



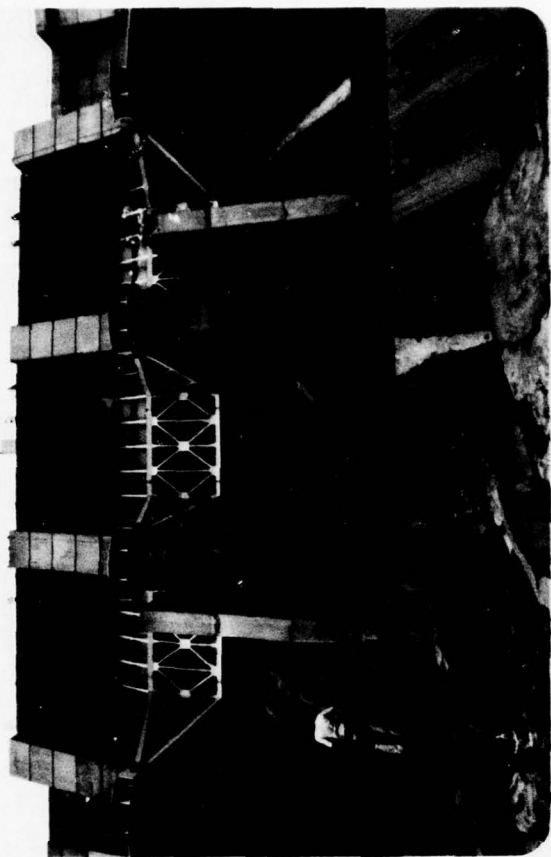
4

PHOTOGRAPH 5 View of the reservoir area showing the wooded slopes surrounding the reservoir.

PHOTOGRAPH 6 View of the mechanically operated radial gates (primary spillway) at the Two Lick Creek facility.

PHOTOGRAPH 7 View of the motor controls for the radial gates shown in the previous photograph.

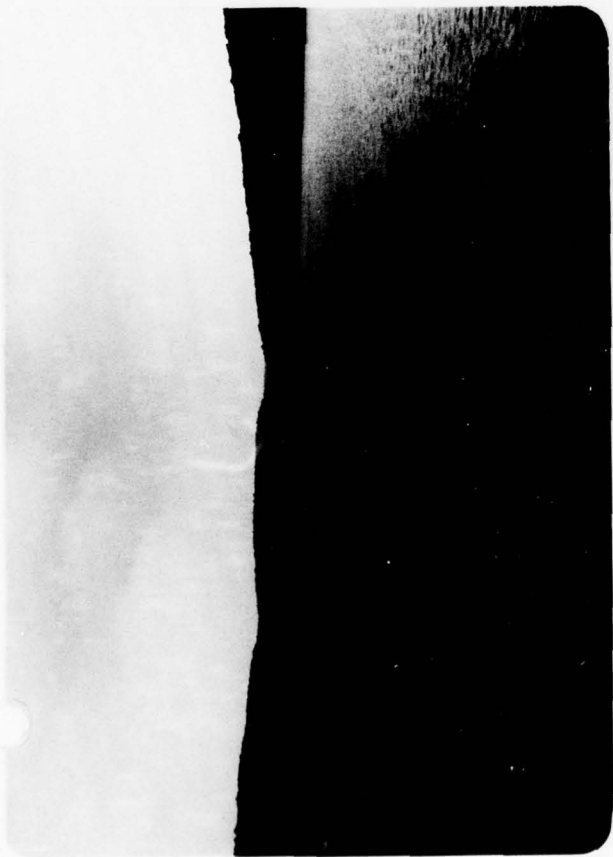
PHOTOGRAPH 8 View of the outlet end of the discharge tunnel at the Two Lick Creek facility.



6



8



5



7

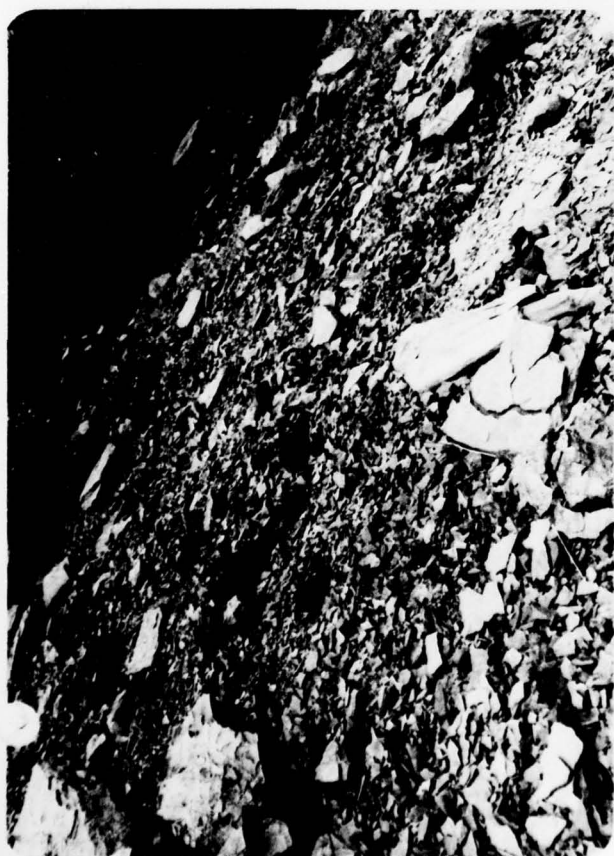
PHOTOGRAPH 9    Close-up view of materials comprising the downstream face of the earth section of Two Lick Creek Dam.

PHOTOGRAPH 10    View of the standing water at the toe of Two Lick Creek Dam. The water is impounded by an earthen dike which serves as the left bank of the stream just downstream of the dam (see Photograph 11).

PHOTOGRAPH 11    View of erosion in the rock channel at the outlet of the emergency spillway (foreground). The pool of water and earth dike mentioned in the previous photograph can be seen in the left background. Note the character of the valley just downstream of the dam.

PHOTOGRAPH 12    View of erosion damage at the intersection of the emergency spillway and the rock abutment. A coal seam was eroded out in this area.





9



10



11



12

PHOTOGRAPH 13

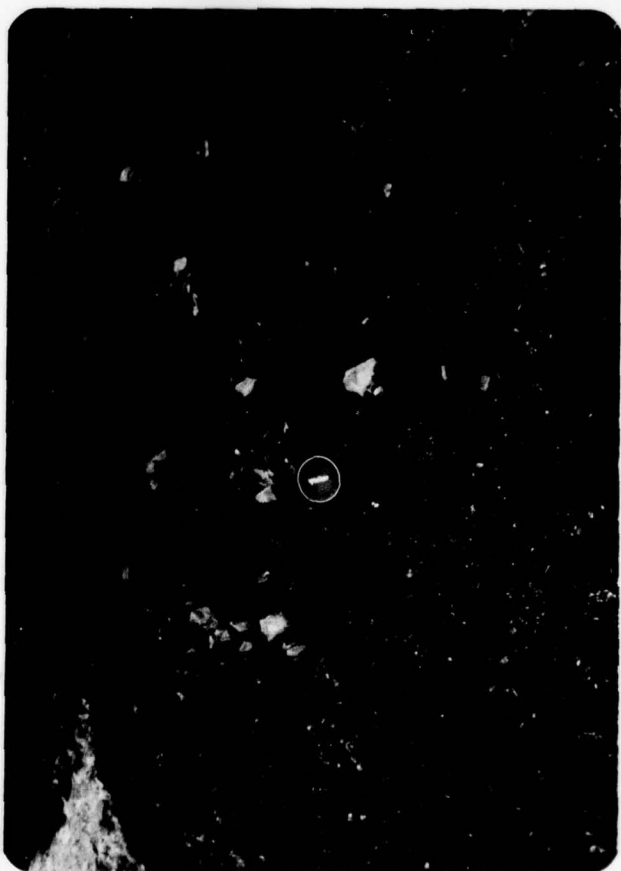
Close-up view of concrete deterioration on the primary spillway apron. The orange-brown color suggests that the discharge may be corrosive in nature.

PHOTOGRAPH 14

View of the first major obstruction downstream of Two Lick Creek Dam consisting of a concrete bridge over a secondary road approximately 3-1/2 miles downstream of the dam. About six homes are located adjacent to the creek at this point.



14



13

APPENDIX E

GEOLOGY



## GEOLOGY

Two Lick Creek Dam is located in the eastern portion of the Appalachian Plateau Physiographic Province.

Soils in the vicinity of the dam are principally alluvial and colluvial. The alluvial soils occupy the floodplain of Two Lick Creek and are sometimes intermixed with colluvial soils which moved down the steep sided slopes characteristic of this valley. The thicknesses of the alluvial materials varied from 0 to 20 feet and the colluvium had a thickness range of 3 to 15 feet. Within the dam's substantial drainage area, the majority of soils are residual and have overburden thicknesses from 2 to 20 feet.

Stratigraphically, the bedrock beneath the dam site consists of strata from the lower portion of the Allegheny Group of Pennsylvanian age. This sequence is composed chiefly of sandstone with some shale, siltstone, and coal. Rocks within the dam's watershed are all Pennsylvanian age and include strata from the Conemaugh Formation and the Allegheny and Pottsville Groups. The extent of mining at the dam site was limited to two small country bank operations in the Lower Kittanning coal upstream of the dam. Numerous mining operations occur within the drainage area of the dam and are chiefly strip mines.

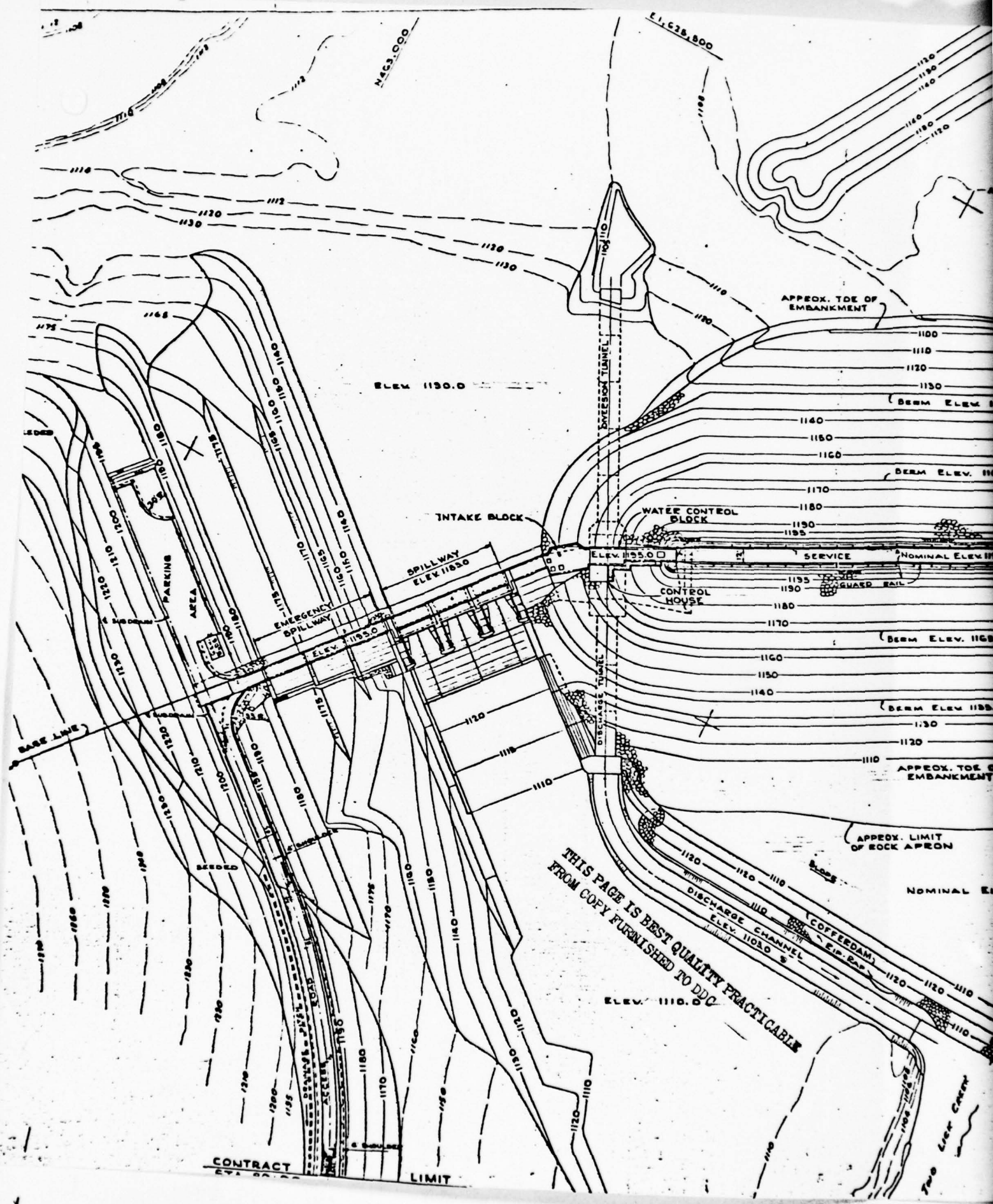
The dam site is located on the west limb of the north-east trending Chestnut Ridge anticline. The rocks are nearly flat lying with minor dip to the northwest. One fault was located upstream of the dam during investigations prior to dam construction. A maximum vertical displacement of 10 feet was estimated for the fault. No major shear zone was associated with this fault and no subsurface faulting was disclosed by the drilling investigation.

APPENDIX F

FIGURES

## TABLE OF CONTENTS

<u>Figure</u>	<u>Description/Title</u>
1	General Plan
2	Data Sheet
3	Concrete, General Plan
4	Stability Analysis, Concrete Section
5	Geologic Sections
6	Rock-fill Embankment, Sections
7	Embankment Stability Analysis
8	Plan-1st Stage Construction Diversion, Cofferdam and Earth Core
9	Concrete, General Sections
10	Radial Gates, General Arrangement
11	Radial Gates, General Arrangement (Details)



ELEV 1130.0

INTAKE BLOCK

SPILLWAY  
ELEV 1185.0

WATER CONTROL  
BLOCK

CONTROL  
HOUSE

ELEV 1135.0

SERVICE

NOMINAL ELEV 1135.0

GUARD RAIL

(BERM ELEV 1125.0)

(BERM ELEV 1125.0)

APPROX. TOE OF EMBANKMENT

APPROX. LIMIT OF ROCK APRON

NOMINAL EL

ELEV 1110.0

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CONTRACT

LIMIT

COFFERDAM

ELEV 1102.0

DISCHARGE CHANNEL

ELEV 1102.0

Two Line Cherry



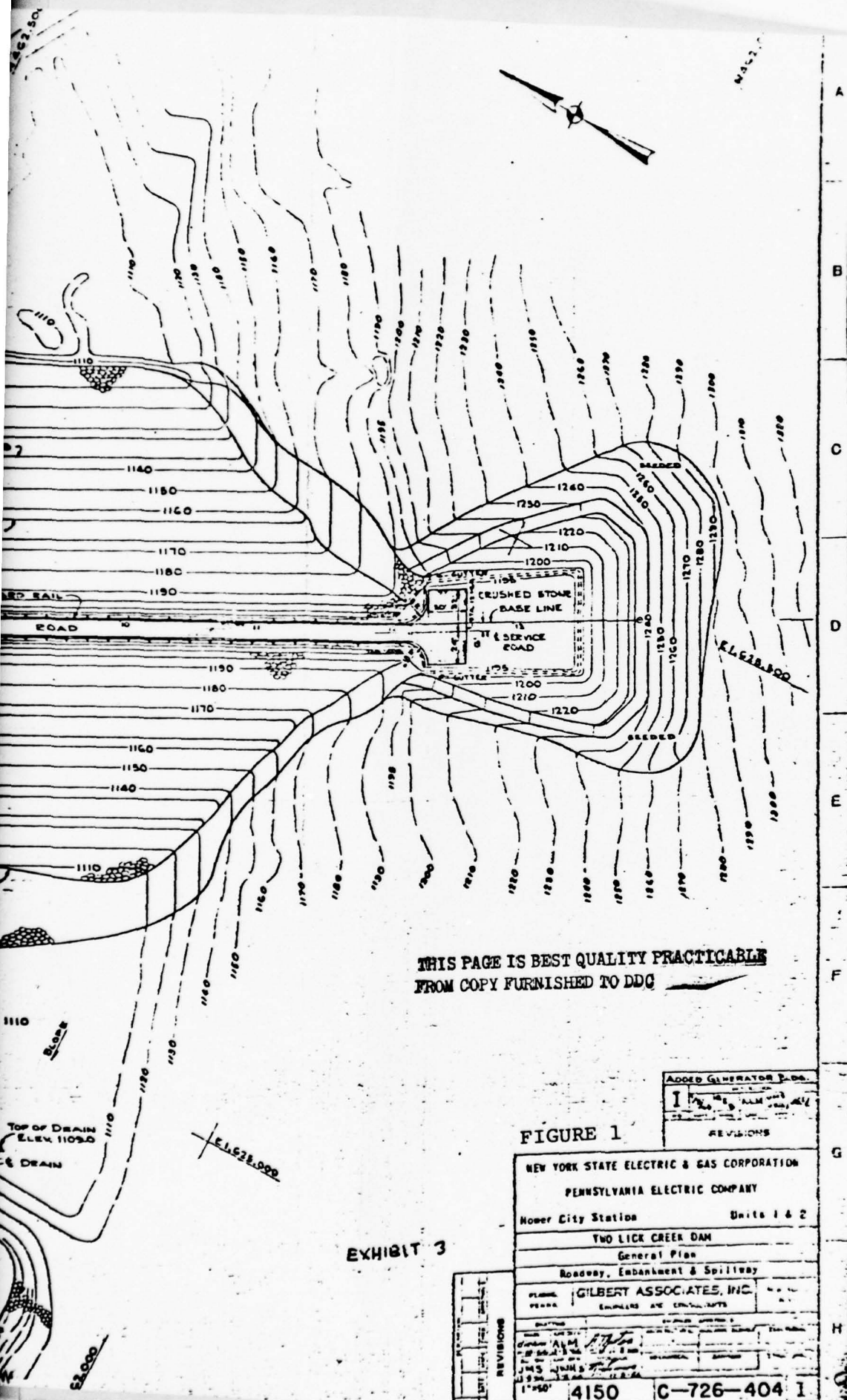


FIGURE 1

NEW YORK STATE ELECTRIC & GAS CORPORATION  
PENNSYLVANIA ELECTRIC COMPANY  
Homer City Station Units 1 & 2  
TWO LICK CREEK DAM  
General Plan  
Roadway, Embankment & Spillway

PLANNED BY GILBERT ASSOCIATES, INC.  
ENGINEERS AND ARCHITECTS  
4150 C-726-404 1

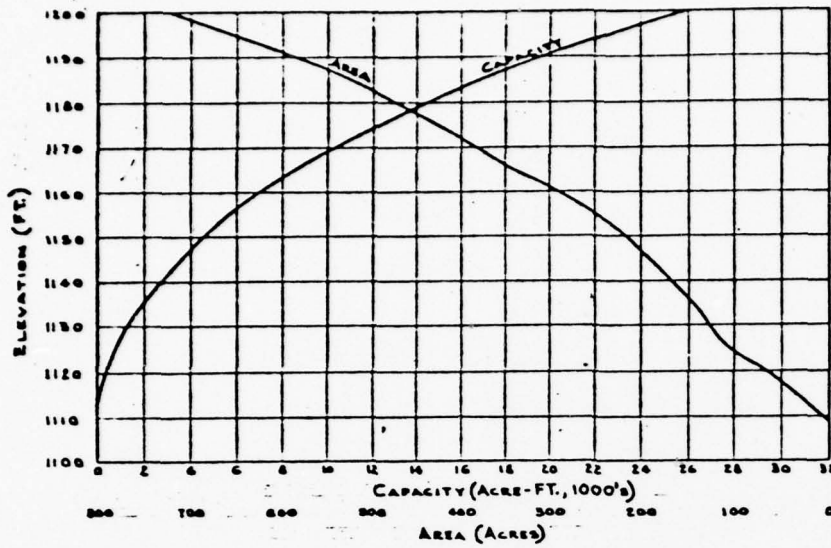
EXHIBIT 3

REVISIONS	DATE	BY	DESCRIPTION
1	11-15-50	JMS	Initial Design
2	11-15-50	JMS	Revised Design
3	11-15-50	JMS	Final Design

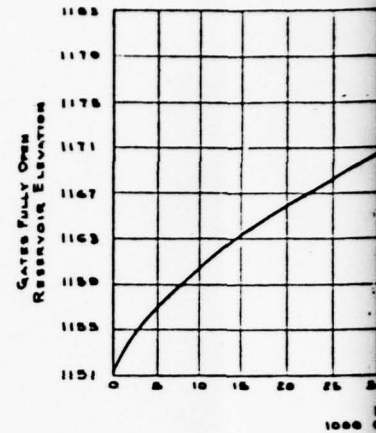
ADDED GENERATOR P.D.
1
REVISIONS
1

A

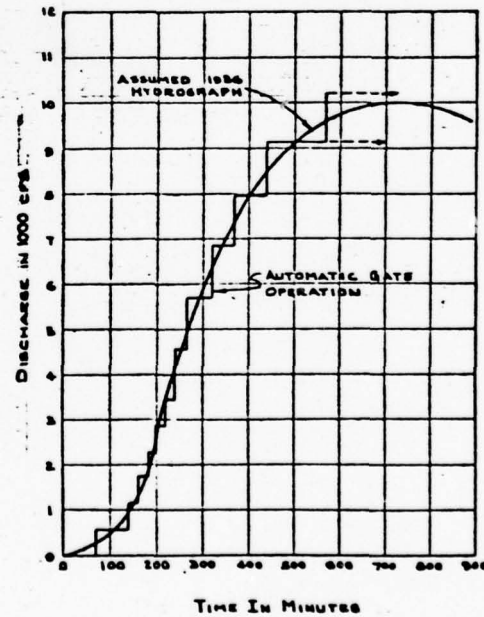
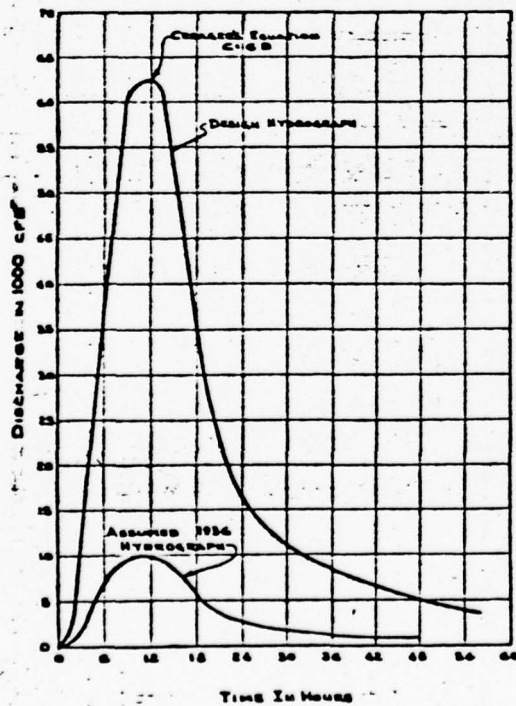
## RESERVOIR CAPACITY AREA CURVES



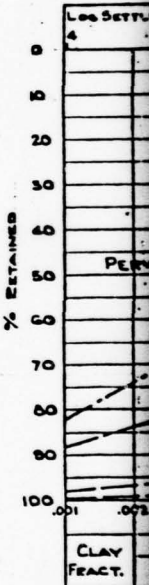
## SPILLWAY



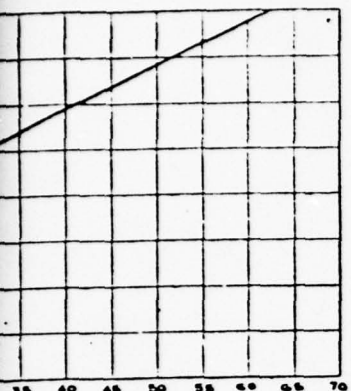
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## HYDROGRAPHS

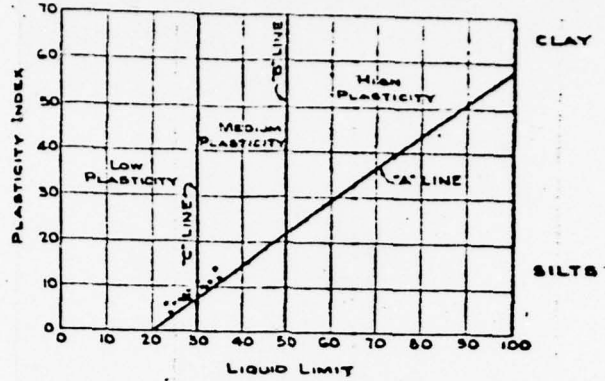


EATING CURVE



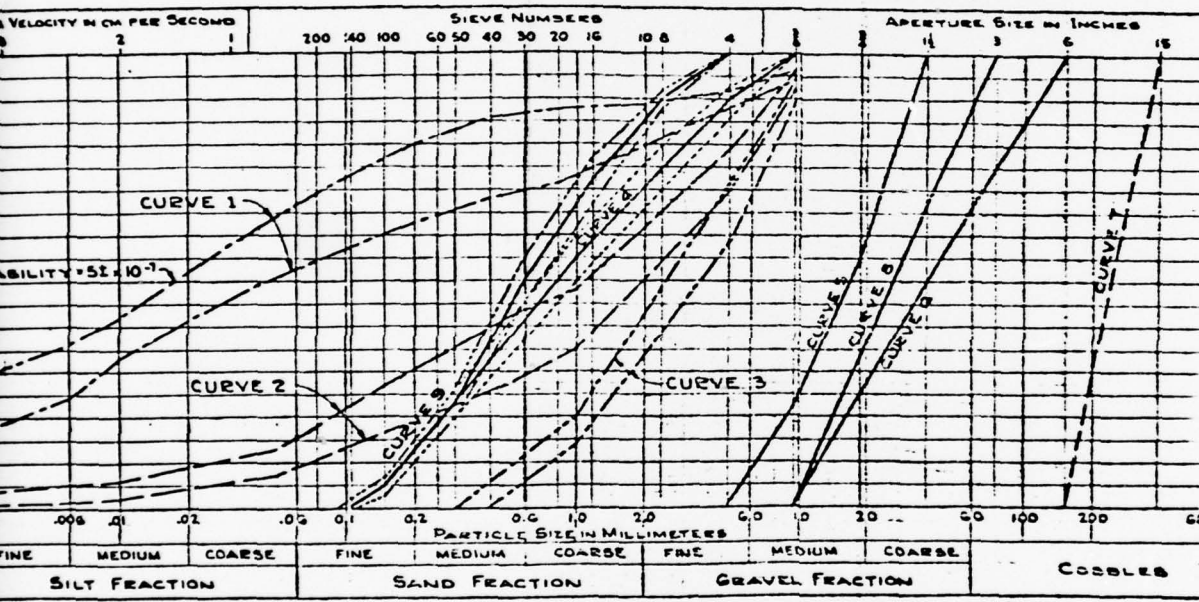
RECHARGE  
ME POST PER SEC.

MINUS #4 SIEVE SOIL FRACTION

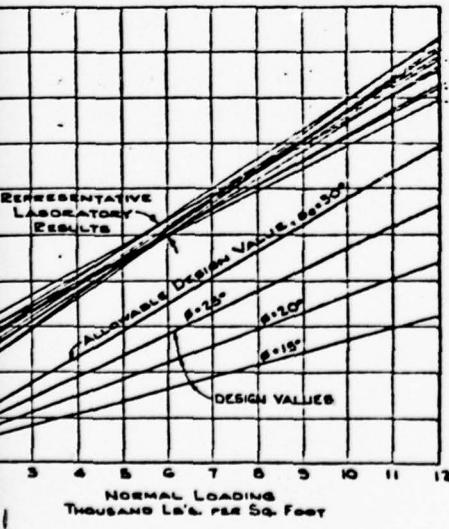


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GRADATION CURVES



STRENGTH PARAMETERS



Laboratory results are total stresses obtained from Consolidated Undrained Triaxial Tests.

CURVE	AVERAGE GRADATION OF:
1	Impervious Core Material - Zone A
2	Transitional Earth Fill - Zone B
3	Fine Filter - Zone C
4	Sand (Fine aggregate) Interior Concrete
5	Coarse aggregate - Face Concrete
6	Coarse Filter (Finer Quarry-run rock)
7	Quarry-run rock (Approx.)
8	Coarse aggregate - Interior Concrete
9	Sand (Fine aggregate) Face Concrete

FIGURE 2

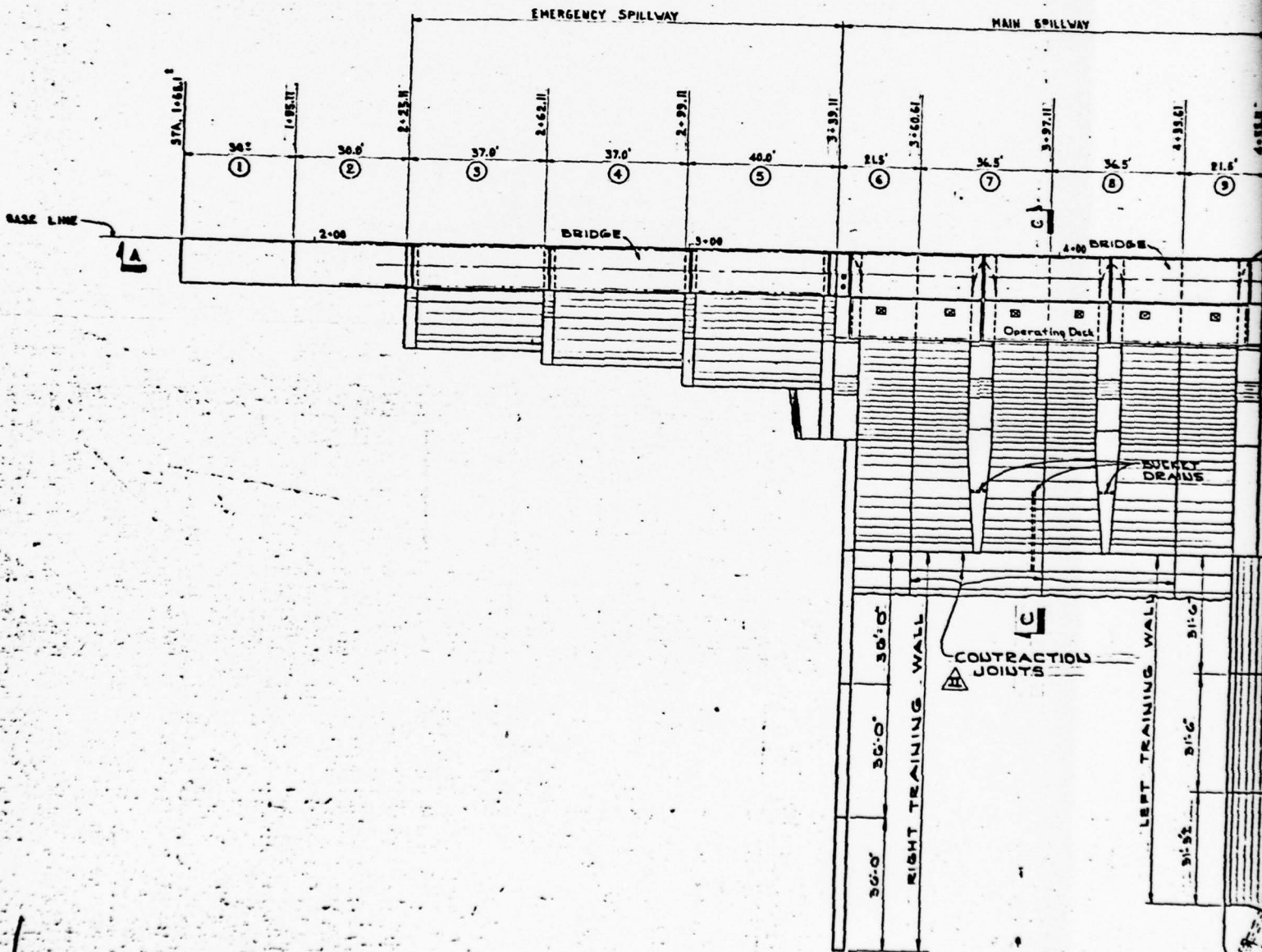
EXHIBIT 8

Revised Curve 1: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4	Revised Curve 2: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4	Revised Curve 3: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4	Revised Curve 4: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4	Revised Curve 5: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4	Revised Curve 6: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4	Revised Curve 7: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4	Revised Curve 8: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4	Revised Curve 9: Added new Curve 3 changed only Curve 5 to Curve 8 revised Description of Curve 4
---	---	---	---	---	---	---	---	---

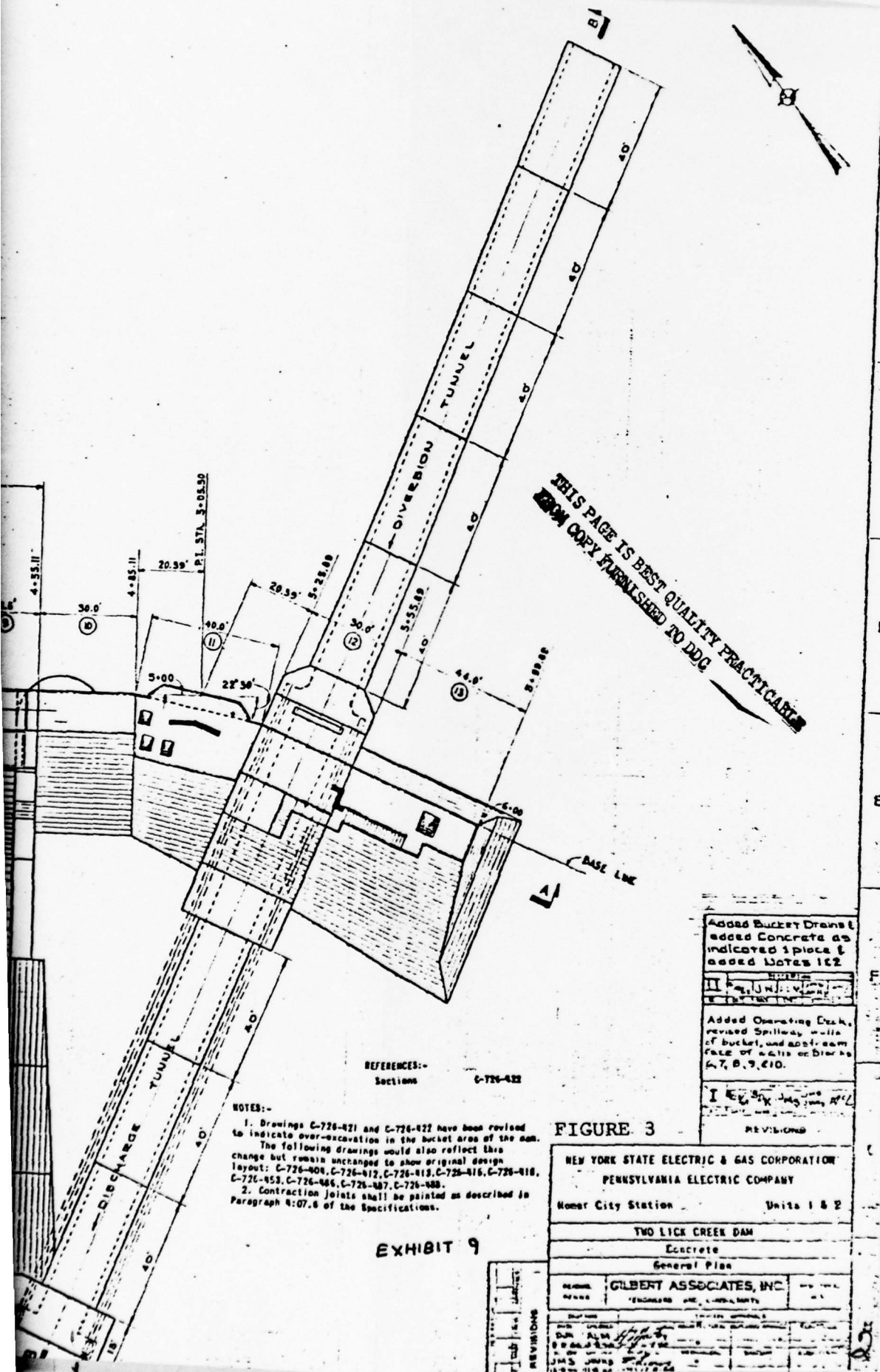
NEW YORK STATE ELECTRIC  
PENNSYLVANIA ELECTRIC  
Homer City Station  
TWO LICK C  
Data Sheet  
REVISIONS  
GILBERT ASSO  
4150 C



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REFERENCES:-  
Sections C-726-422

NOTES:-  
1. Drawings C-726-421 and C-726-422 have been revised to indicate over-excavation in the bucket area of the dam. The following drawings would also reflect this change but remain unchanged to show original design layout: C-726-404, C-726-412, C-726-413, C-726-415, C-726-416, C-726-453, C-726-466, C-726-467, C-726-488.  
2. Contraction joints shall be painted as described in Paragraph 4:07.6 of the Specifications.

EXHIBIT 9

FIGURE 3

NEW YORK STATE ELECTRIC & GAS CORPORATION  
PENNSYLVANIA ELECTRIC COMPANY

Homer City Station Units 1 & 2

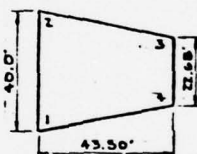
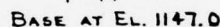
TWO LICK CREEK DAM

Eccheto

General Plan

DESIGNED BY GILBERT ASSOCIATES, INC.  
ENGINEERS AND ARCHITECTS

REVISIONS	DATE	BY	REASON
1	10-1-54	JMS	Initial Design
2	10-1-54	JMS	Revised Design
3	10-1-54	JMS	Final Design



BASE	CASE	2H	2V	STRESSES LBS./SQ. IN.					
				$f_v$	$f_d$	$f_s$	$f_t$	$f_c$	$f_b$
1160	I		46.8	21.1	27.1	27.1	27.1	0.0	
	II	6.2	43.3	14.8	14.8	35.4	35.4	3.1	63.3
	III	6.2	43.3	14.8	14.8	35.4	35.4	3.1	63.3
	IV	10.3	41.1	13.5	13.5	36.7	36.7	2.6	63.3
1128	I		22.2	7.0	7.0	3.8	3.8		
	II	10.0	170.0	17.1	17.1	44.6	44.6	17.0	63.9
	III	10.0	170.0	16.8	16.8	43.3	43.3	16.3	63.9
	IV	14.0	130.0	12.5	12.5	35.0	35.0	27.1	66.6

BASE EL.	CAME	I H KIPS	I V KIPS	STRESSES LBS./SQ. IN.					
				$f_u$	$f_t$	$f_c$	$f_v$	$f_s$	$f_v$
1147.0	I	23	42.03	68.1	7.8	11.9	5.3	0.3	63.7
	II	147.0	42.13	24.7	254	46.9	151	64.1	151
	III	147.0	42.13	244	25.4	46.9	151	64.1	151
	IV	2298	42.13	1.1	4.5	77.4	83.3	73.5	65.0
112.6	I	145	76.42	68.3	6.0	10.4	15.4	0.8	66.5
	II	3775	76.93	7.0	5.8	83.2	84.3	75.2	66.6
	III	3672	69.71	4.2	3.0	70.3	72.2	71.0	63.5
	IV	4720	65.64	8.2	7.0	60.0	61.5	74.0	63.5

BASE	CASE	Z W KIPS	Z V KIPS	STRESSES LBS./SQ. IN.					
				$f_u$	$f_d$	$f_1$	$f_2$	$f_3$	$f_4$
1127	Z	-	4790	48.8	48.8	18.5	18.5	-	62.9
	X	2103	4328	10.3	10.3	41.0	41.0	15.8	63.6
	Y	1487	3843	8.3	16.2	32.8	32.8	9.5	63.2
	IV	2796	444	-5.1	-3.1	58.8	59.8	18.0	63.7

**Uplift Assumptions  
(100% of Base Area)**

1. Where drains exist against rock  
Upstream-full headwater  
At Drains-Tailwater plus  $d$  (Headwater minus Tailwater)  
Downstream-full tailwater
2. in concrete (No Drains)  
full headwater to tailwater  
Diagram at 67% intensity

**NOTES:-**

1. Dimensions and purposes only and
2. Design cases:

Case 3: 1

0000 11

Case 11:  $\frac{1}{2}$

Case 1774

**Call us!**

100

Case 11:

10

Is free. No.

100% positive

Scale are at

...are at

19.

3:

- Algebraic

- Algebraic

- Base stress

- Base stro

— Average of

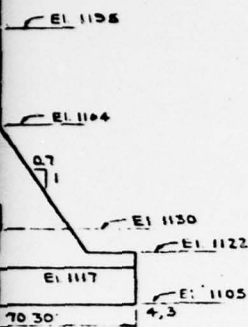
• Average of  
• All available

- Allowable  
for 1/5 $W = 1/3$ 

\_\_\_\_\_

\_\_\_\_\_

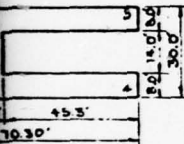
BE LINE



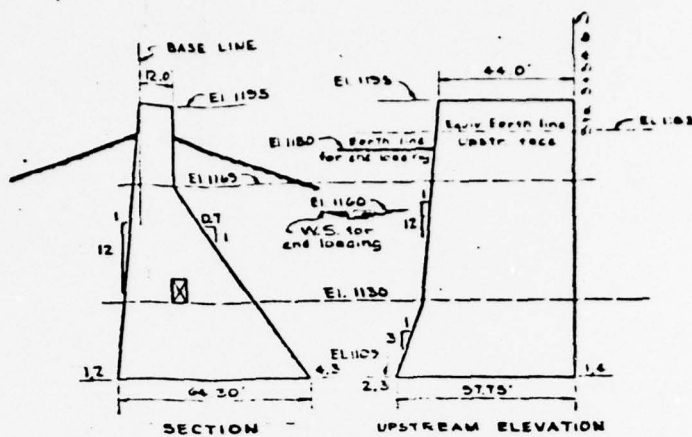
OCK 12



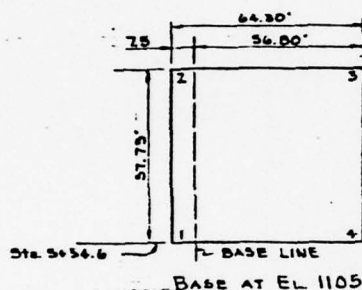
EL 1130



AT EL 1105



SECTION - UPSTREAM ELEVATION  
Block 13



BASE AT EL 1105

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V	STRESSES LBS./SQ. IN.					
	fu	fu	fu	fu	fu	fu
0.03	82.0	82.0	35.5	35.5	1.0	67.7
0.09	35.5	35.5	35.5	35.5	15.5	65.5
0.05	35.1	35.1	34.3	34.3	16.3	65.6
0.15	17.3	17.3	71.0	71.0	22.0	65.8
0.19	10.3	10.3	77.3	77.3	2.4	71.7
0.27	10.4	10.4	155.1	155.1	24.5	70.8
0.22	8.9	8.9	134.1	134.1	22.0	62.5
0.27	12.3	12.3	182.1	182.1	34.1	71.0

BASE EL.	CASE	Σ H KIPS	Σ V KIPS	STRESSES LBS./SQ. IN.					
				f1	f2	f3	f4	f5	f6
1185	I	140	3855	620	20	2.1	1.6	55.3	
	II	125	3662	843	4.7	2.1	7.0	15	46.4
	III	125	3662	643	4.7	2.1	7.0	15	65.4
	IV	128	4454	463	4.6	4.8	55.5	33	64.5
1130	I	1570	12331	75.6	55.5	12.5	27.4	5.5	68.0
	II	3200	10231	35.4	55.5	33.6	57.0	11.6	68.0
	III	3200	10107	35.4	55.2	33.1	55.2	11.6	65.0
	IV	3550	10603	25.0	5.1	4.8	71.1	13.1	68.0
1105	I	4870	27082	1013	383	4.1	12.8	9.1	64.6
	II	7200	22410	55.8	4.6	14.9	83.5	17.2	64.5
	III	7500	22166	55.3	0.7	12.2	64.7	14.7	63.5
	IV	8050	23192	50.5	0.4	36.5	54.6	16.2	63.5

and foundation elevations shown are for design  
and are not to be used for construction.

Dead load of concrete, fill in place,  
reservoir empty.

HW EL. 1185.0', TW EL. 1110.0'.

HW EL. 1185.0', TW EL. 1135.0'

spillway gates fully open.

HW EL. 1182.0', TW EL. 1125.0'

Spillway gates closed, Case IV is  
an emergency design case only.

Uplift of Case II used.

Pressure used in Case IV for block II & III.

at 4' downstream of base line.

Σ is summation of forces parallel to base of section.

Σ is summation of forces normal to base of section.

press at upstream face.

press at downstream face.

shear stress on base.

shear stress on base. (Rock surface only;

3000 ÷ 0.65 average vertical stress)

FIGURE 4

NEW YORK STATE ELECTRIC & GAS CORPORATION  
PENNSYLVANIA ELECTRIC COMPANY  
Homer City Station Units 1 & 2

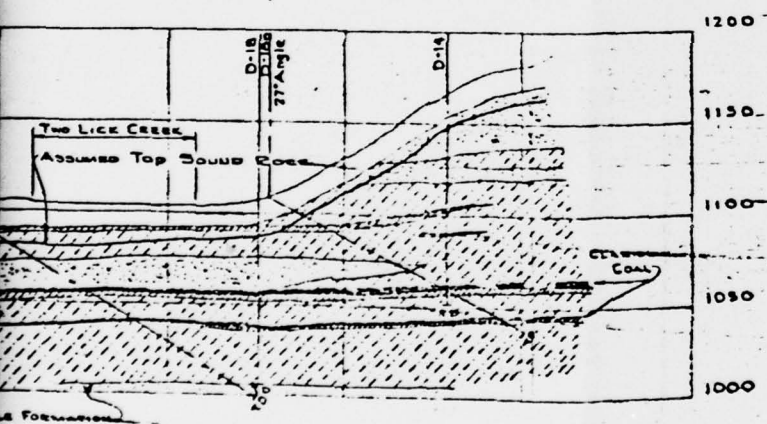
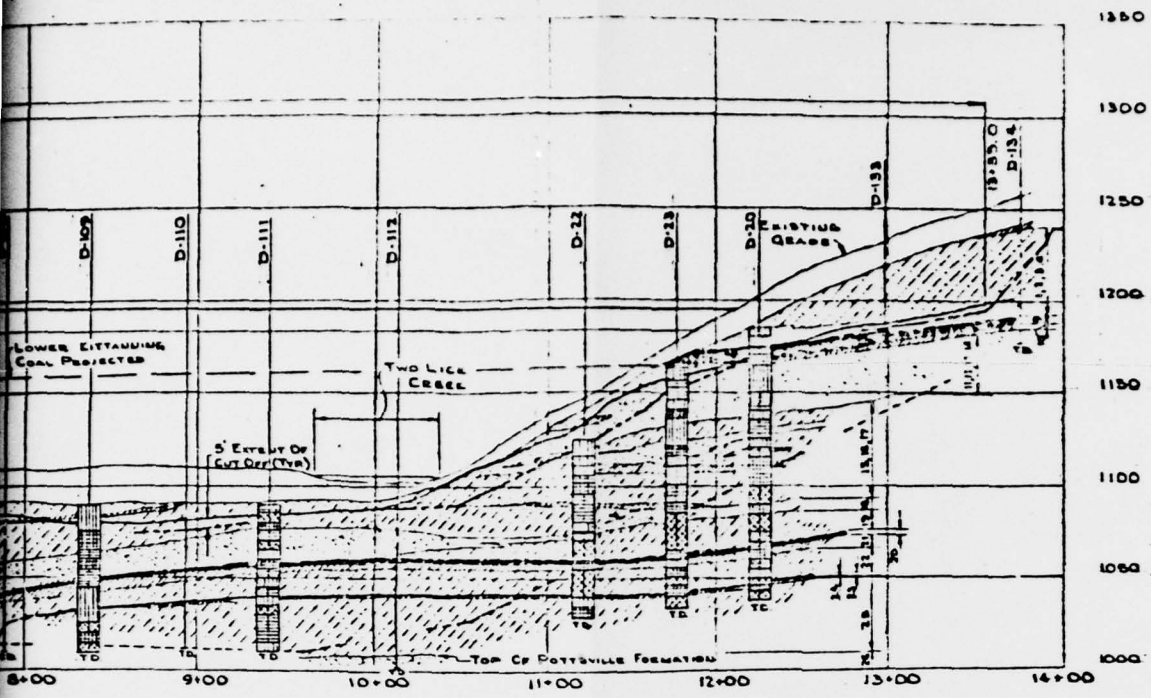
TWO LICK CREEK DAM  
Stability Analysis

Concrete Section

REVISIONS	DATE	BY	CHKD.	DESCRIPTION
1	10/1/54	JMS	JMS	Initial Design
2	10/1/54	JMS	JMS	Revised Design
3	10/1/54	JMS	JMS	Final Design







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LEGEND

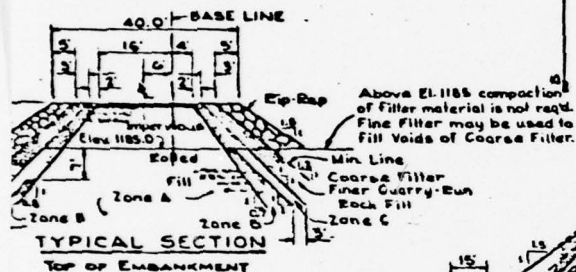
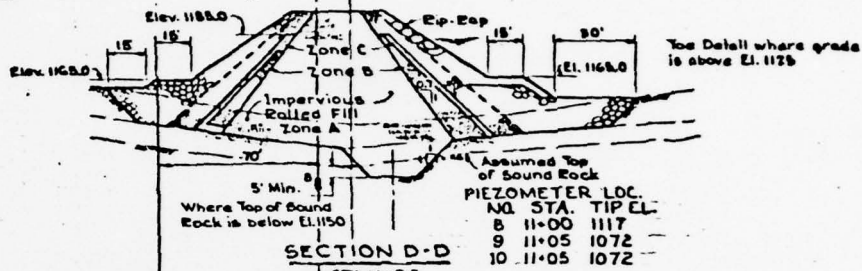
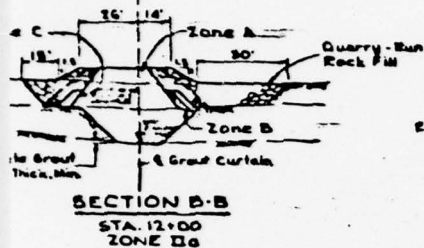
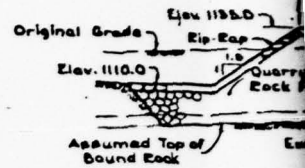
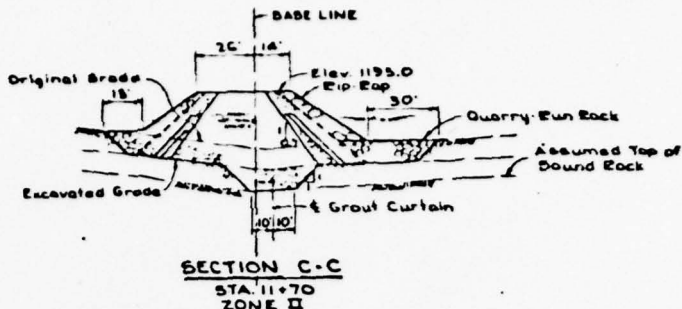
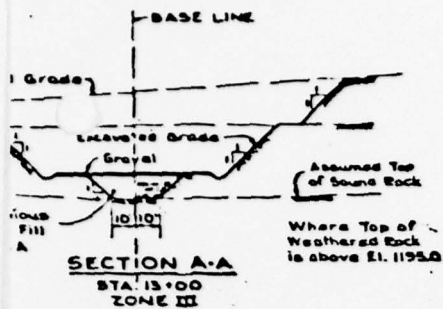
- Overburden
- Sandstone
- Siltstone-Some interbedded Sandstone & Shale
- Coal-(Some seams include Shale Layers)
- Underclay
- T.B. - Total Depth
- PRESSURE TEST-PERMEABILITY IN CM/SEC
- $10^{-3}$
- $10^{-4}$
- $10^{-5}$
- Less than  $10^{-5}$

REFERENCE:-  
Plot Plan  
C-798-508

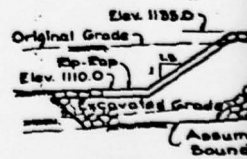
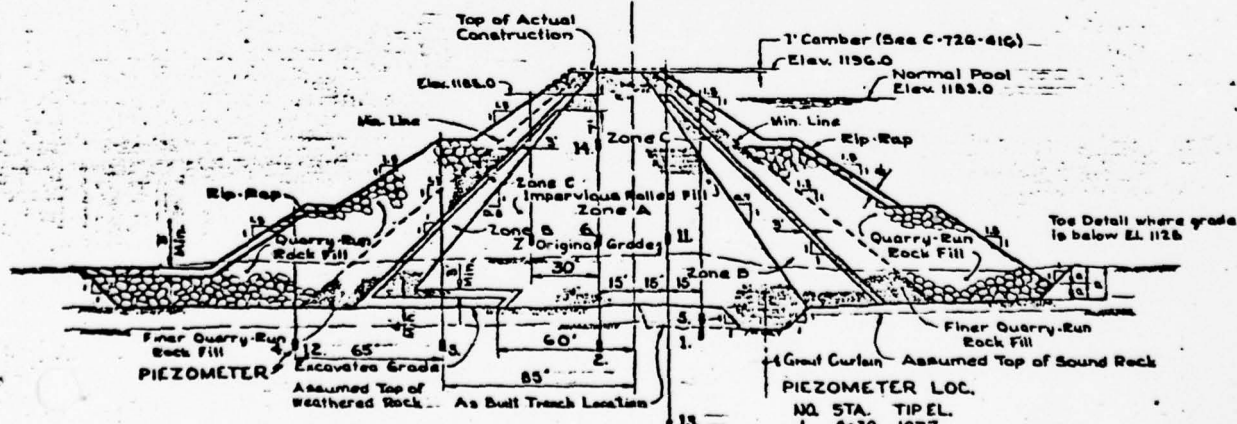
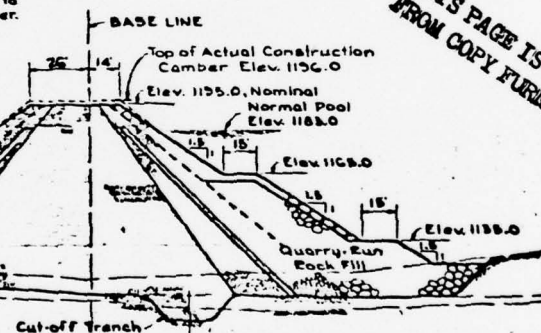
EXHIBIT 12

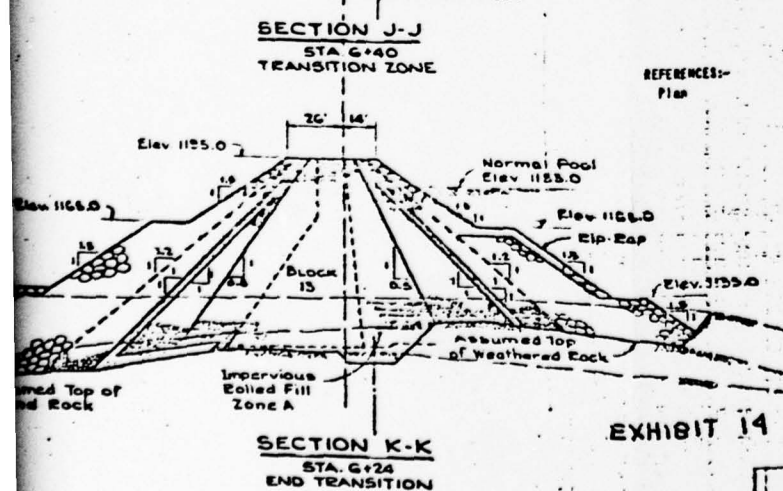
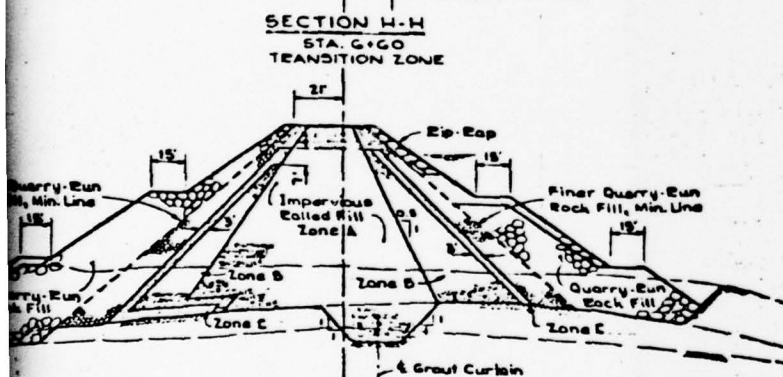
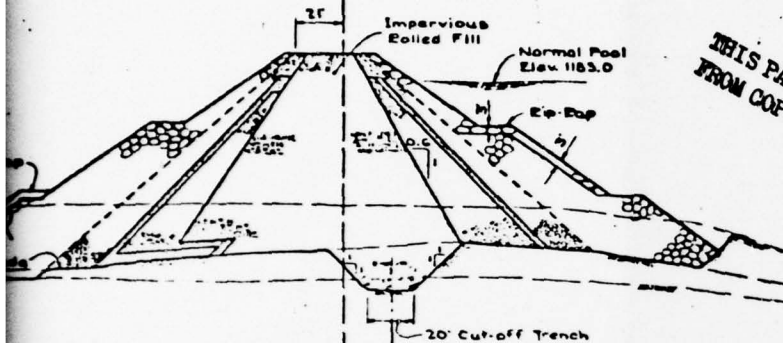
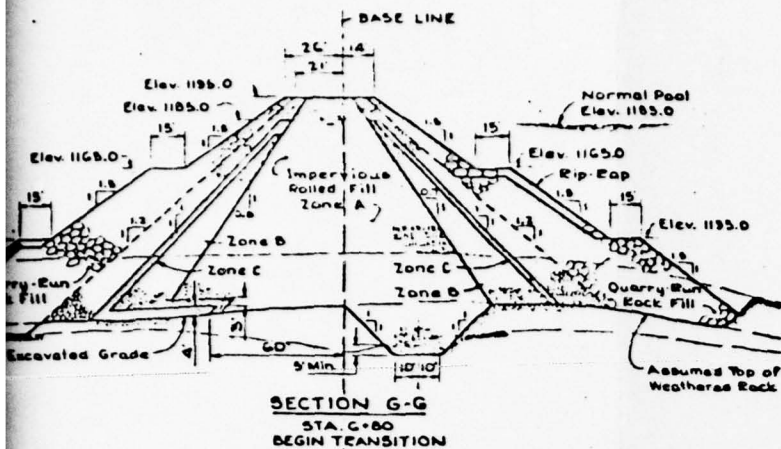
FIGURE 5

NEW YORK STATE ELECTRIC & GAS CORPORATION	
PENNSYLVANIA ELECTRIC COMPANY	
Homer City Station	Units 1 & 2
TWO LICK CREEK DAM	
Geologic Sections	
DRAWN BY: GILBERT ASSOCIATES, INC. CHECKED BY: ST. ANDREWS AND COMPANY, INC. DATE: 11-4-60 11-4-60 11-4-60 11-4-60 11-4-60	



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REFERENCES:  
Plan

6-729-418

FIGURE 6

NEW YORK STATE ELECTRIC & GAS CORPORATION		
PENNSYLVANIA ELECTRIC COMPANY		
Homer City Station		Units 1 & 2
TWO LICK CREEK DAM		
Rock Fill Embankment		
Sections		
GILBERT ASSOCIATES, INC.		
ENGINEERS AND CONSULTANTS		
NOV 1966		
REVISIONS		
I 2.00 11/17/66		
II 2.00 11/17/66		
III 2.00 11/17/66		
IV 2.00 11/17/66		
V 2.00 11/17/66		
VI 2.00 11/17/66		
VII 2.00 11/17/66		
VIII 2.00 11/17/66		
IX 2.00 11/17/66		
X 2.00 11/17/66		
XI 2.00 11/17/66		
XII 2.00 11/17/66		
XIII 2.00 11/17/66		
XIV 2.00 11/17/66		
XV 2.00 11/17/66		
XVI 2.00 11/17/66		
XVII 2.00 11/17/66		
XVIII 2.00 11/17/66		
XIX 2.00 11/17/66		
XX 2.00 11/17/66		
XXI 2.00 11/17/66		
XXII 2.00 11/17/66		
XXIII 2.00 11/17/66		
XXIV 2.00 11/17/66		
XXV 2.00 11/17/66		
XXVI 2.00 11/17/66		
XXVII 2.00 11/17/66		
XXVIII 2.00 11/17/66		
XXIX 2.00 11/17/66		
XXX 2.00 11/17/66		

EXHIBIT 14



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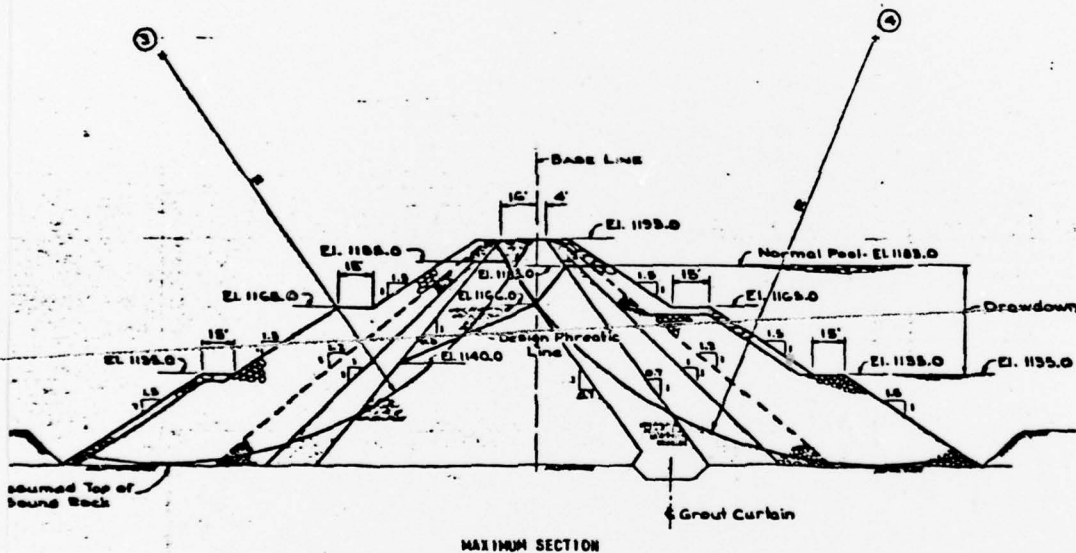
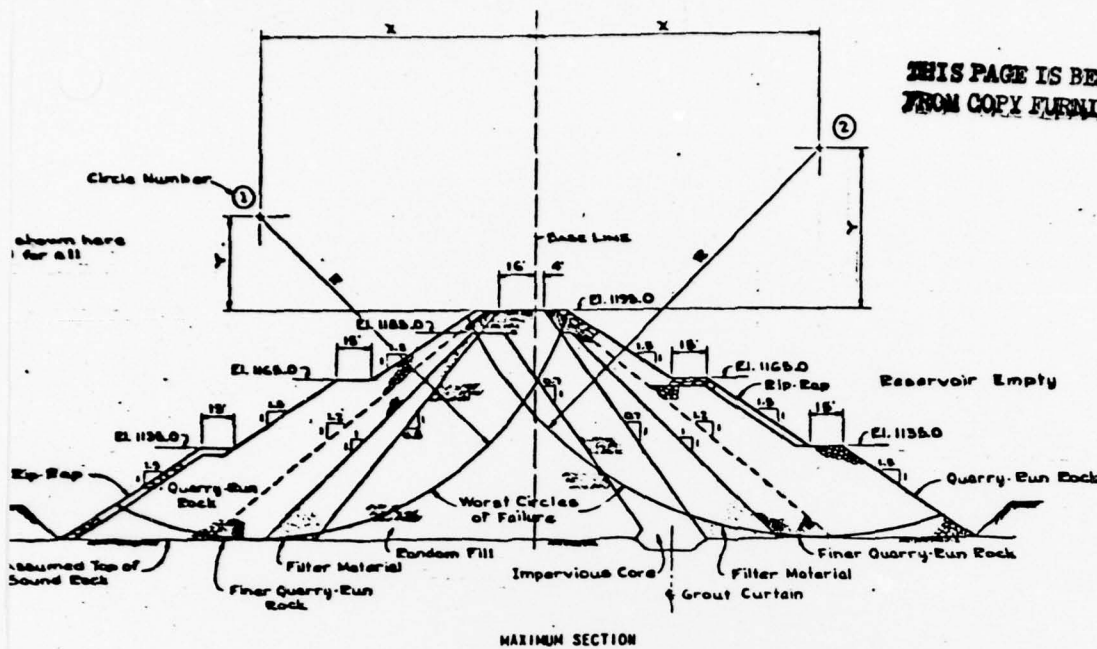


TABLE I

Mode of Circle	Case I	Case II	Case III
I	20°	20°	25°
II	15°	20°	25°
III	15°	20°	25°

$\phi = 15^\circ$ ,  $\tan 15^\circ = .268$ ,  $p = 56\%$   
 $\phi = 20^\circ$ ,  $\tan 20^\circ = .364$ ,  $p = 58\%$   
 $\phi = 25^\circ$ ,  $\tan 25^\circ = .466$ ,  $p = 20\%$

SUMMARY - CIRCLE ANALYSIS

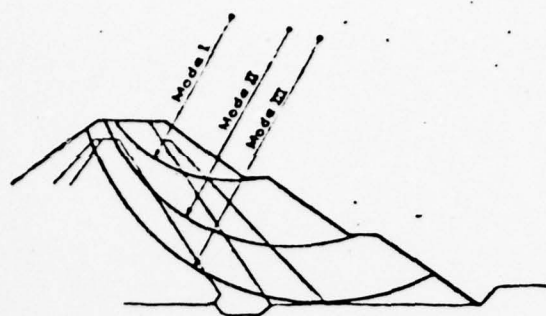
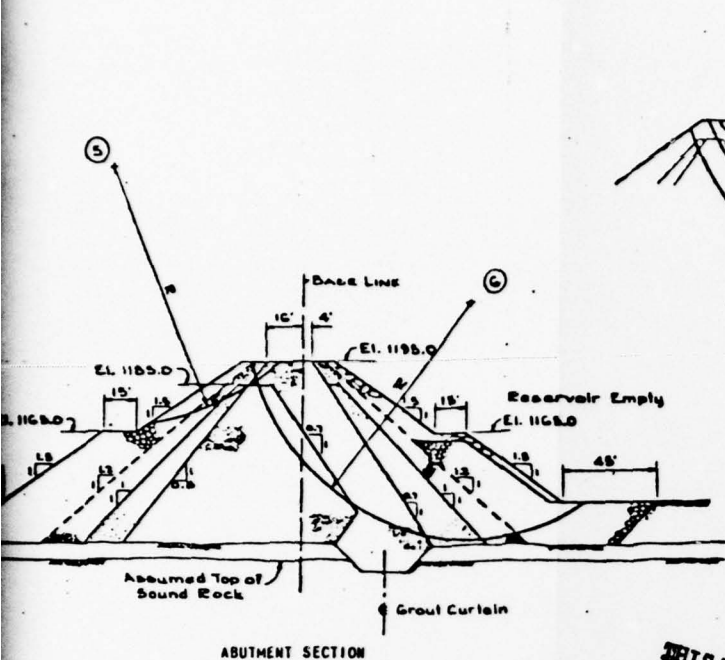
Section	Circle	Case	X Feet	Y Feet	Z Feet	Entons Pounds	Lc	ST Pounds	Fs	Mode
Maximum	1	I	120.6	41.8	141.8	456,290	0	370,780	1.25	III
"	2	I	124.0	70.0	170.0	521,680	0	380,550	1.37	III
"	3	II	164.6	81.8	181.8	406,220	0	225,150	1.59	III
"	4	III	148.6	83.8	183.8	433,950	0	286,460	1.52	III
Abutment	5	I	64.0	84.0	112.0	31,120	0	22,710	1.37	I
"	6	I	76.0	26.0	102.0	277,180	0	215,340	1.29	II
"	7	II	76.0	68.0	96.0	34,810	0	25,050	1.39	I
"	8	III	96.0	70.0	142.0	290,070	0	211,510	1.37	II

PROPERTIES OF MAT

Material	Moist Weight lb/cu.ft	Saturated Weight lb/cu.ft	Buoyant Weight lb/cu.ft
Rip-Rap	110	-	70
Quarry Eun Rock	110	-	70
Finer Quarry Eun Rock	110	-	70
Filter Material	110	-	70
Impervious Core	128	141	78.5
Random Fill	128	141	78.5
Overburden	118	135	78.5

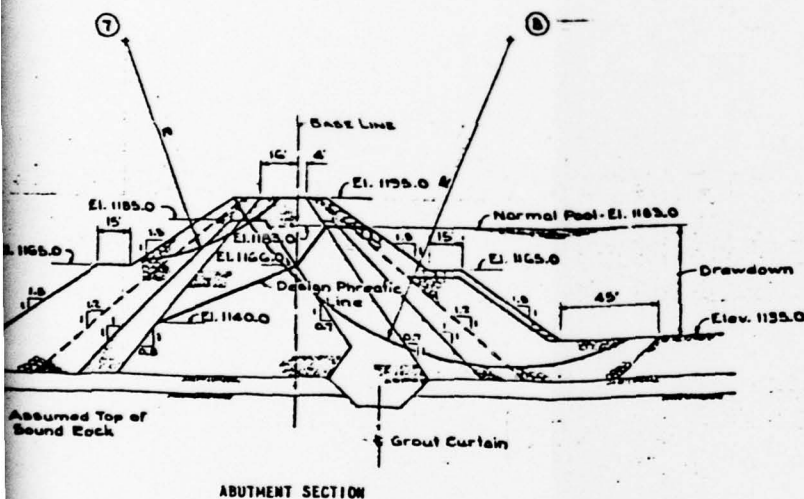
DESIGN STRENGTH  
 $S = (W-U) \tan 30^\circ$   
 $P = 100\%$





For each section of discontinuous slope there is a separate mode of failure which will give a "minimum" factor of safety. Materials at higher elevations in the fill have higher design strengths due to smaller pore pressures. Table I gives the phi angle values by case & mode. The lower modes are shown on the maximum section & the higher modes are shown on the abutment section.

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# SERIALS

φ	tan φ	C lb/sq. ft.
43°	.933	0
43°	.933	0
43°	.933	0
36°	.726	0
See Table 1		0
See Table 1		0
15°	.268	0

CASE I: End of Construction  
Reservoir Empty

CASE II: Normal Operating Condition  
HW EL. 1185.0  
TW EL. 1110.0  
Fully Developed Phreatic Line

CASE III: Sudden Drawdown Condition  
HW EL. 1135.0  
TW EL. 1110.0  
Fully Developed Phreatic Line

Dimensions & Elevations given are for design purposes only & are not to be used for construction.

EXHIBIT 15

FIGURE 7

REVISIONS		
NO.	DATE	DESCRIPTION

NEW YORK STATE ELECTRIC & GAS CORPORATION		
PENNSYLVANIA ELECTRIC COMPANY		
Romer City Station		Units 1 & 2
TWO LICK CREEK DAM		
Embankment Stability Analysis		
DESIGNED BY	GILBERT ASSOCIATES, INC.	CHECKED BY
DATE	ENGINEER AND CONSULTANT	DATE
PROJECT NO.		

**INVERSION**  
**INTAKE CHANNEL**  
**FINISHED GRADE -**  
**ELEV. 1108**

NOTE: COFFER  
SUGGESTS  
SHOWS M  
STEEL C

- 1 SHEET PILE COPPERDAM  
20' CELLS - USS MP112 OR EQUAL  
TOP ELEV. 1140

1.0' CAMBER  
TOP ELEV. 119

BACKBILL TUNNEL EXCAVATION  
To EL 1130.0 WITH ROCK FILL—

ΔΡΡΕΟΧ.

APPROX. TO  
EARTH

STEEL SHEET PILE, TOP ELEV. 1170.0  
U.S.S. MP 112 OR EQUAL  
- ROCK FILL BEHIND PILE

ROCK FILL BEHIND PILE

NOMINAL	ELEV.
100	100
200	200
300	300
400	400
500	500
600	600
700	700
800	800
900	900
1000	1000
1100	1100
1200	1200
1300	1300
1400	1400
1500	1500
1600	1600
1700	1700
1800	1800
1900	1900
2000	2000
2100	2100
2200	2200
2300	2300
2400	2400
2500	2500
2600	2600
2700	2700
2800	2800
2900	2900
3000	3000
3100	3100
3200	3200
3300	3300
3400	3400
3500	3500
3600	3600
3700	3700
3800	3800
3900	3900
4000	4000
4100	4100
4200	4200
4300	4300
4400	4400
4500	4500
4600	4600
4700	4700
4800	4800
4900	4900
5000	5000
5100	5100
5200	5200
5300	5300
5400	5400
5500	5500
5600	5600
5700	5700
5800	5800
5900	5900
6000	6000
6100	6100
6200	6200
6300	6300
6400	6400
6500	6500
6600	6600
6700	6700
6800	6800
6900	6900
7000	7000
7100	7100
7200	7200
7300	7300
7400	7400
7500	7500
7600	7600
7700	7700
7800	7800
7900	7900
8000	8000
8100	8100
8200	8200
8300	8300
8400	8400
8500	8500
8600	8600
8700	8700
8800	8800
8900	8900
9000	9000
9100	9100
9200	9200
9300	9300
9400	9400
9500	9500
9600	9600
9700	9700
9800	9800
9900	9900
10000	10000

STORM WATER  
STORAGE LAGOON  
(For General Plan)  
(See Dwg. C-72G-411)

CONTACT  
STA. 80+00

**LIMIT**

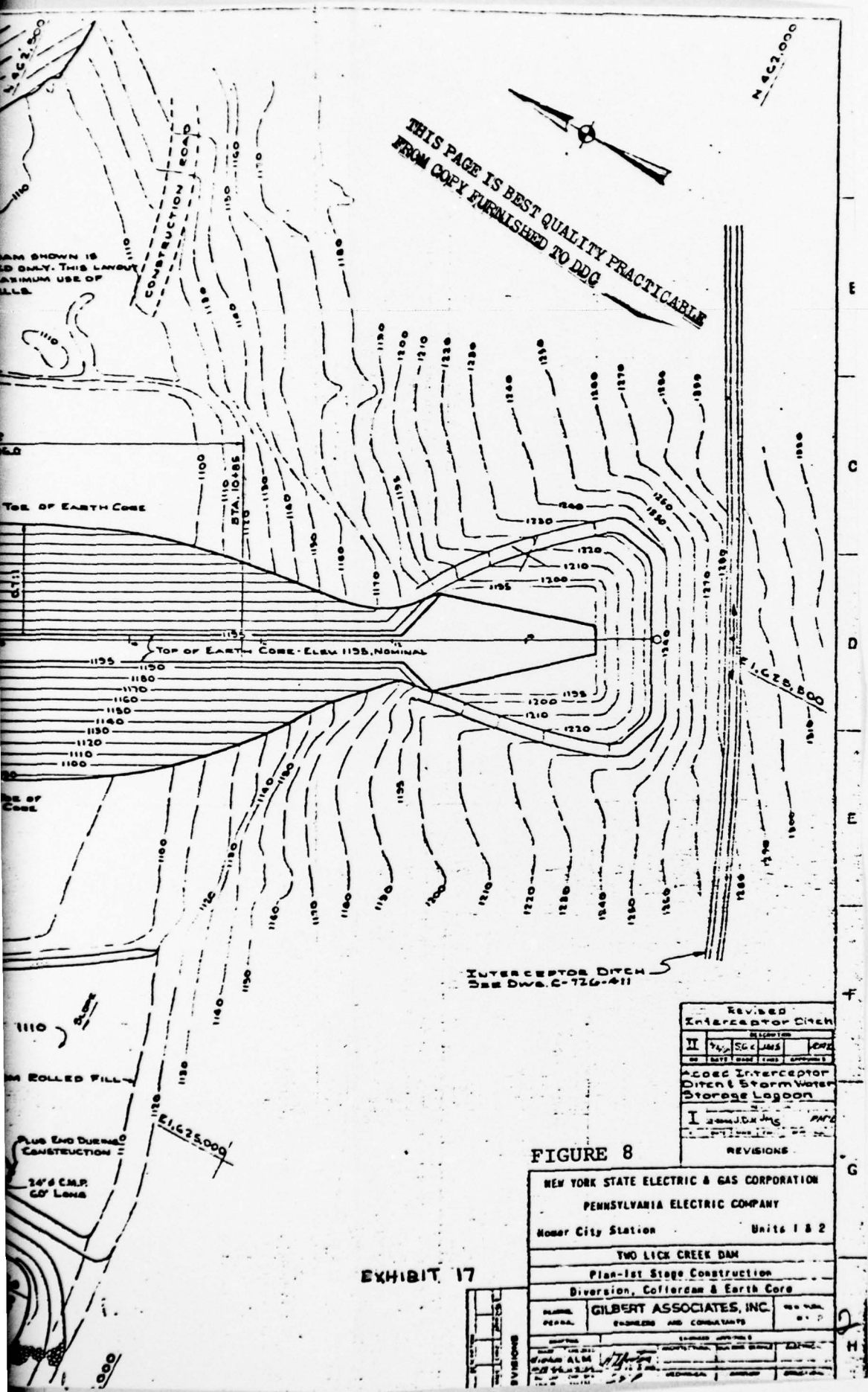


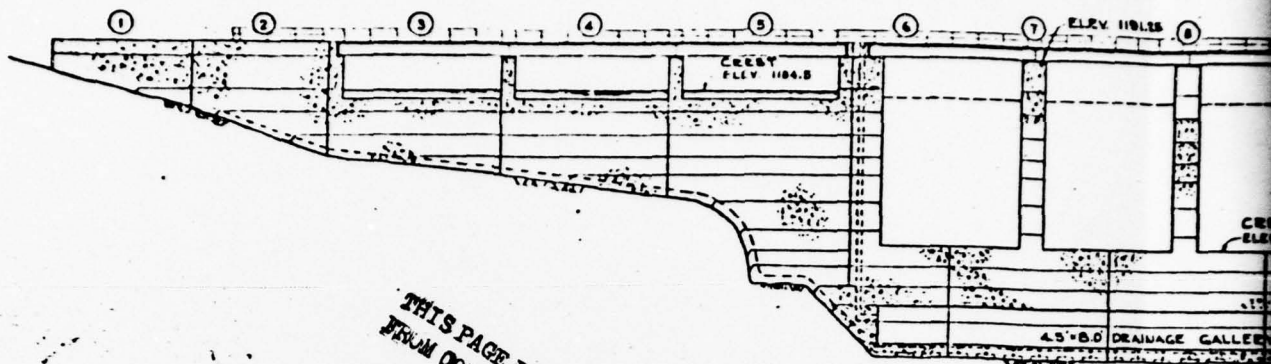
FIGURE 8

EXHIBIT 17

REVISIONS			
NO.	DATE	BY	REVISION
I	10/1/54	J.D.M.	REVISED
II	10/1/54	J.D.M.	REVISED

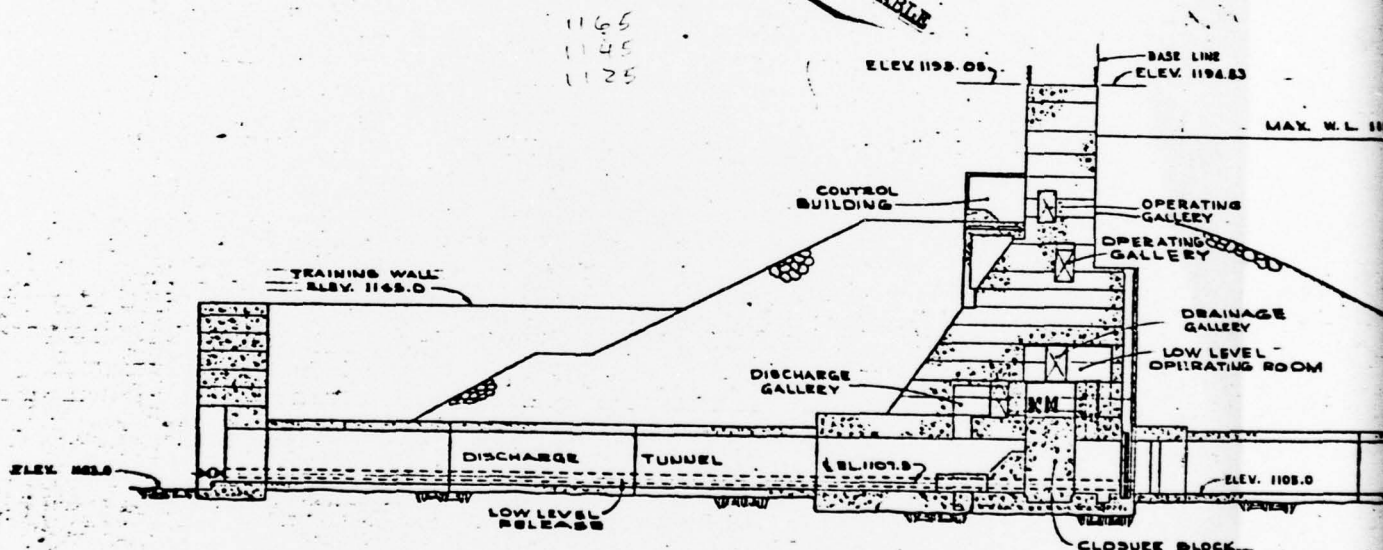
NEW YORK STATE ELECTRIC & GAS CORPORATION	
PENNSYLVANIA ELECTRIC COMPANY	
Homer City Station	Units 1 & 2
TWO LICK CREEK DAM	
Plan-1st Stage Construction	
Diversion, Cofferdam & Earth Core	
DESIGNED BY	GILBERT ASSOCIATES, INC.
CHECKED BY	ENGINEERS AND CONSULTANTS
APPROVED BY	
DATE	
SCALE	
PROJECT NO.	
DATE	





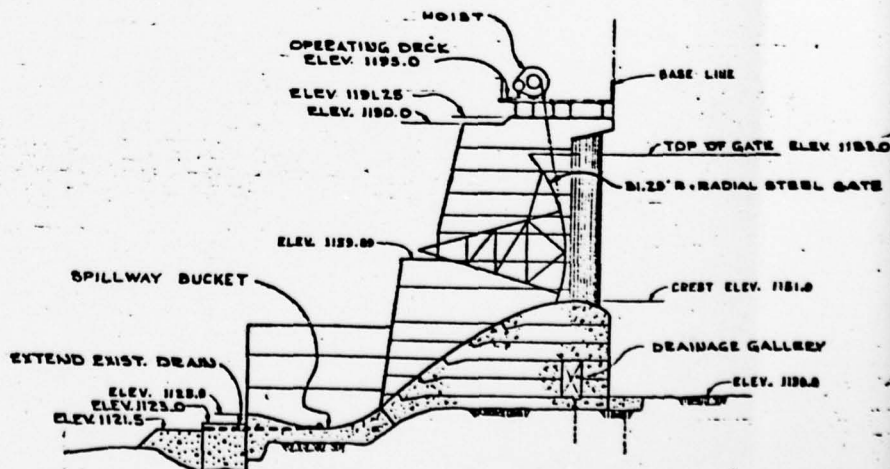
SECTION A-A

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SECTION B-B

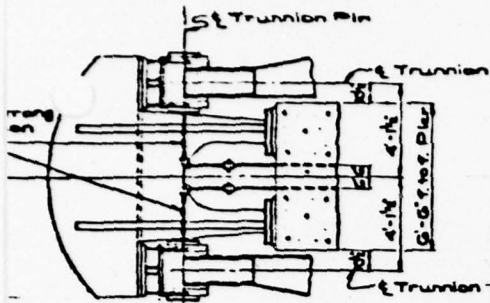
NOTE:  
FOR ADDITIONAL CONCRETE DETAILS  
IN SPILLWAY APRON, SEE DWGS.  
C-716-501, 503 & 504.



SECTION C-C



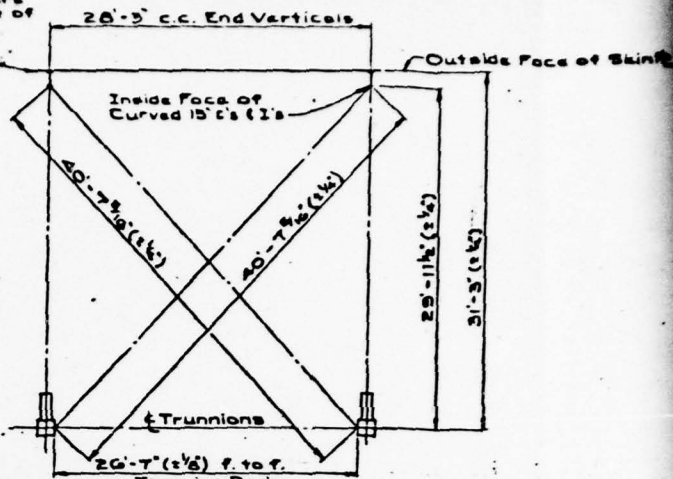




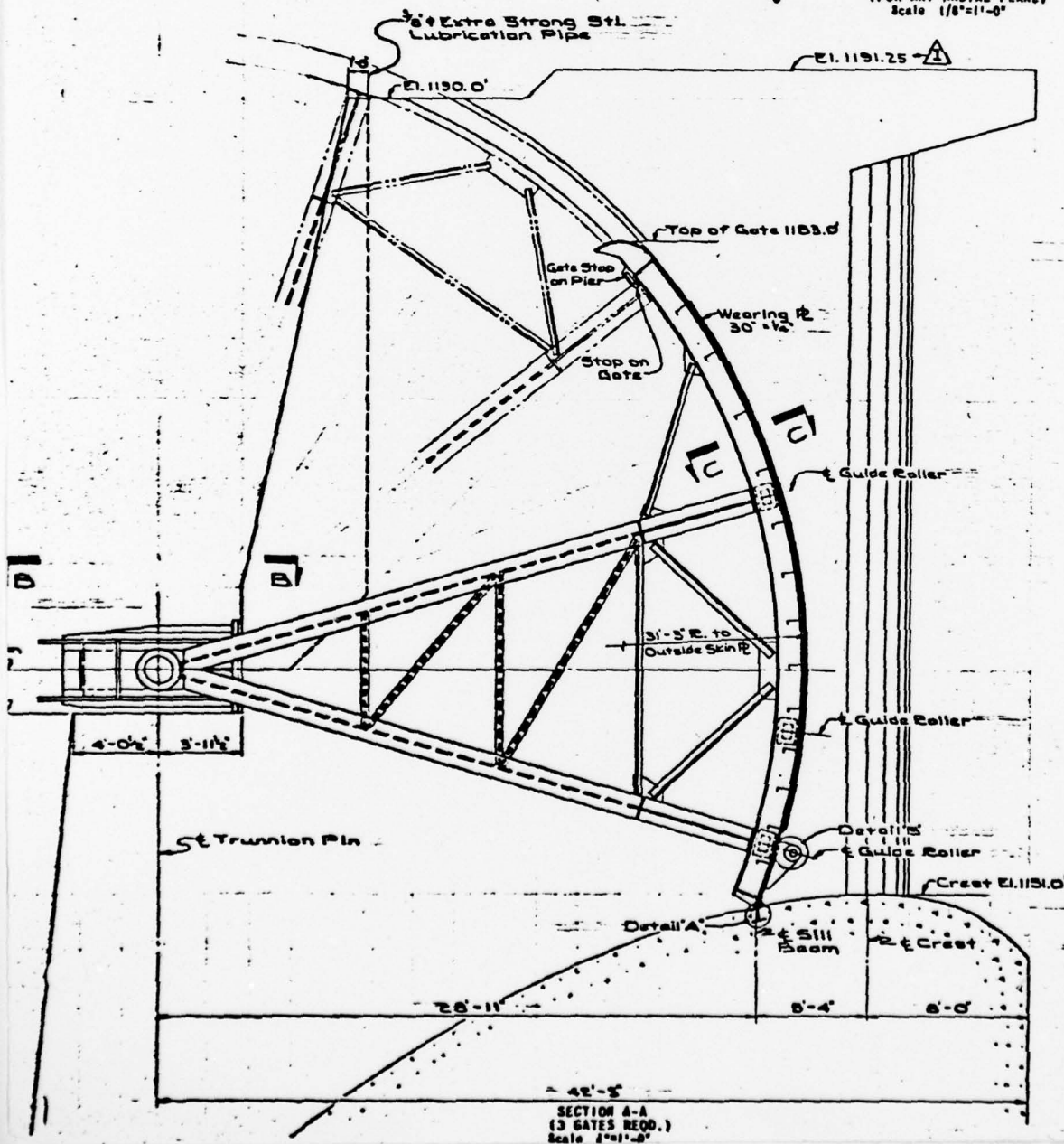
PLAN B-B  
Scale 1/8"=1'-0"

Vertical Edge of Skin R shall not Depart from a Vertical Line by More than 1/8" in Full Height of Gate.

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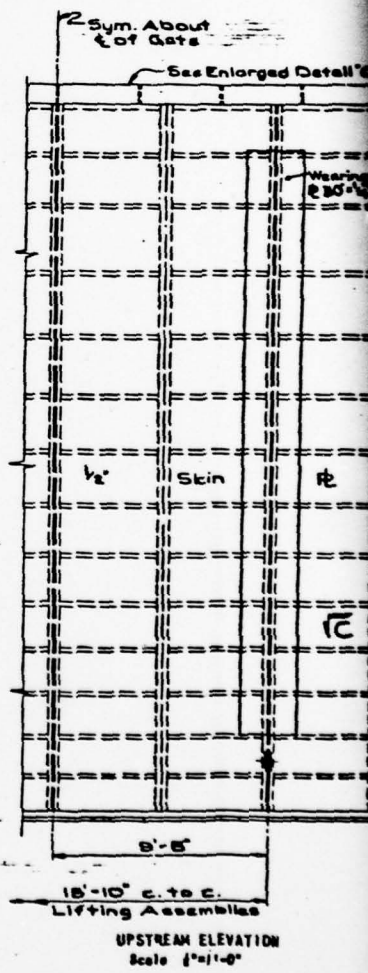


ASSEMBLY TOLERANCES  
(FOR ANY RADIAL PLANE)  
Scale 1/8"=1'-0"

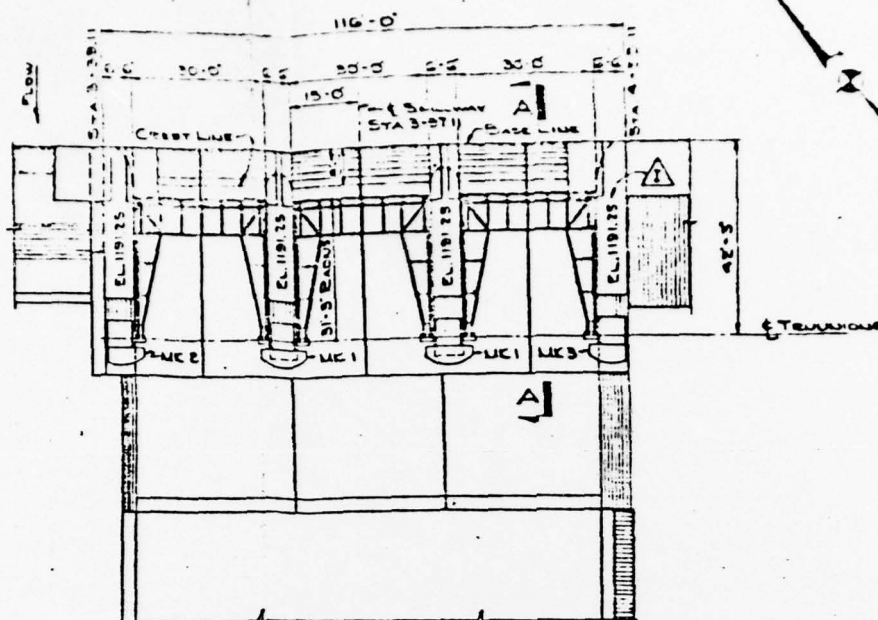


SECTION A-A  
(3 GATES REQ.)  
Scale 1/4"=1'-0"

30'-0" c. to c. Scale - Free



UPSTREAM ELEVATION  
Scale 1/4"=1'-0"



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BILL OF MATERIAL				BILL OF MATERIAL			
MARK	DESCRIPTION	NO. REQD.	MATERIAL	MARK	DESCRIPTION	NO. REQD.	MATERIAL
	Gate Structure	3	Structural Steel	726-464-1	Guide Roller Bearing	18	Steel Casting
726-462-1	Lifting Bar	6	Steel Forging	2	Guide Roller	18	Steel Forging
2	Clevis	8	Steel Forging	3	Guide Roller Bushing	18	Bronze & Graphite
3	Pin & Cotter	12	Steel Forging	5	Guide Roller Pin	18	Steel Forging
				6	Lock Plate	18	Steel
				6	Hex Head Cap Screw 5/8"x1 1/2" lg.	36	Bronze
726-463-1	Gate Trunnion Bearing	6	Steel Casting	7	Dowel Pin 3/8"x5/8" lg.	108	Steel
2	Trunnion Bearing Bushing	6	Bronze	8	Finished Bolt	72	Bolt Steel
3	Finished Bolt	144	Bolt Steel	8	Hex. Head Cap Screw 7/8"x2 1/2" lg.	36	Bronze
4	Fixed Trunnion Bearing	6	Steel Casting	10	Shims	18	Steel
5	Trunnion Pin	6	Steel Forging				
6	Lock Plate	12	Steel	726-465-1	Bottom Rubber Seal	3	Rubber
7	Hex Head Cap Screw 1"x2 1/2" lg.	24	Bronze	2	Corner Rubber Seal	6	Rubber
8	Flat Point Set Screw 5/8"x1 1/2" lg.	24	Bolt Steel	3	Side Rubber Seal	3	Rubber
9	Flat Point Set Screw 5/8"x2" lg.	36	Bolt Steel	4	Side Rubber Seal	3	Rubber
10	Dowel Pin 1/2"x1" lg.	48	Steel	5	Side Seal Bar	4	Steel
11	Machine Bolts	72	Bolt Steel	6	Bottom Seal Bar	3	Steel
				7	Seal Bolt (Side)	624	Bolt Steel
				8	Seal Bolt (Bottom)	208	Bolt Steel
				9	Bevel Wrencher	208	Steel

#### REFERENCES:-

C-726-459

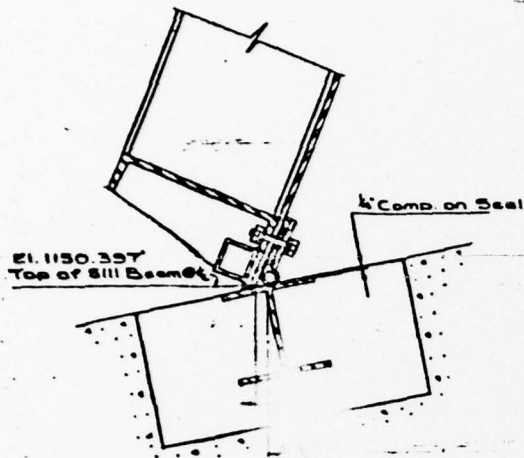
FIGURE 10

Revised Top of Wall Elevation	
I	DISCLAIMER
REVISIONS	

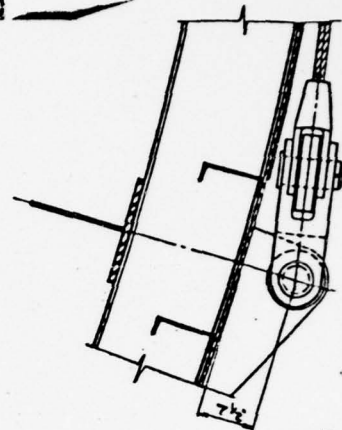
EXHIBIT 19

NEW YORK STATE ELECTRIC & GAS CORPORATION					
PENNSYLVANIA ELECTRIC COMPANY					
Homer City Station			Units 1 & 2		
TWO LICK CREEK DAM Radial Gates					
General Arrangement					
DESIGNED BY <b>PENNA.</b>		<b>GILBERT ASSOCIATES, INC.</b>		DATE PLANNED 1974	
		ENGINEER AND CONSULTANT			
SHEET NO. 1 OF 1		PROJECT NO. 100-1000		DRAWN BY JMS	
CHECKED BY JMS		APPROVED BY [Signature]		DATE 10/1/74	

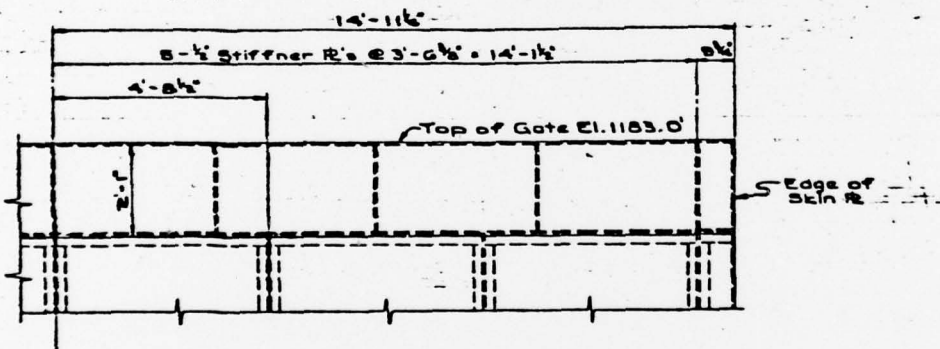
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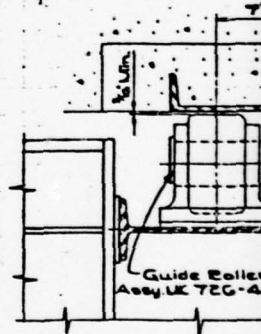
DETAIL "A"  
Scale 1/2"=1'-0"



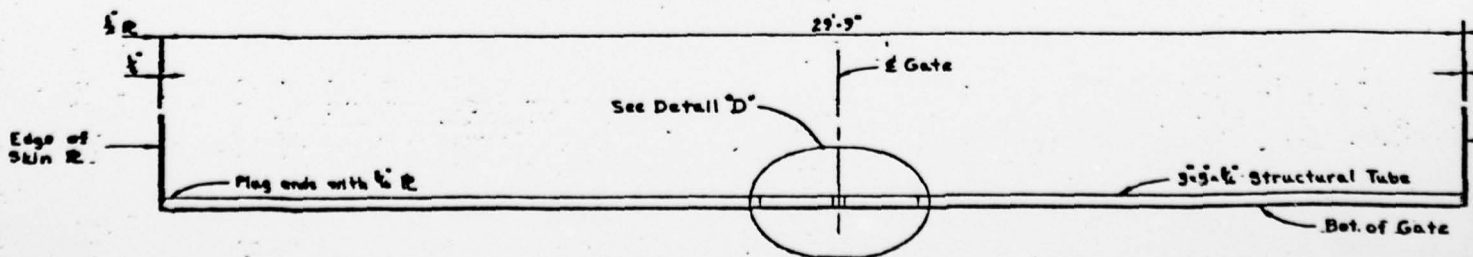
DETAIL "B"  
Scale 1/2"=1'-0"



DETAIL "C"  
Scale 1/2"=1'-0"



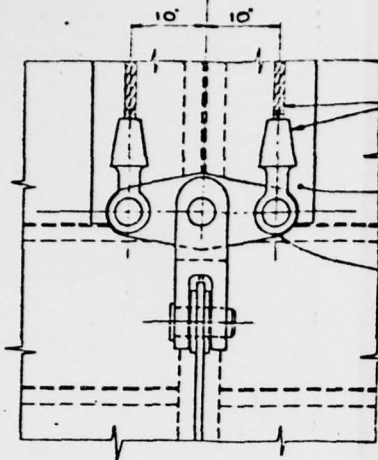
SECTION  
Scale 1/2"=1'-0"



ELEVATION-TUBE FOR HEATING ELEMENT



16'-10" c.to.c. Lifting  
Assemblies



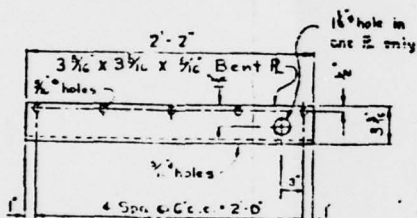
SECTION D-D

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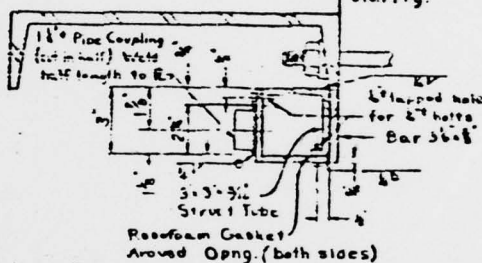
1" Wire Rope (Socket  
(By Others)

Wearing Pl

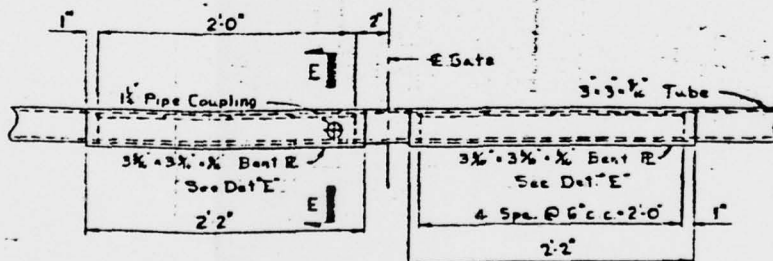
Lifting Assy.  
MKTEG-AGE



DETAIL "E-E"  
Scale 1 1/2"=1'-0"



SECTION E-E  
Scale 3"=1'-0"



DETAIL "D-D"  
Scale 1 1/2"=1'-0"

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FIGURE 11

REFERENCES:-  
General Arrangement

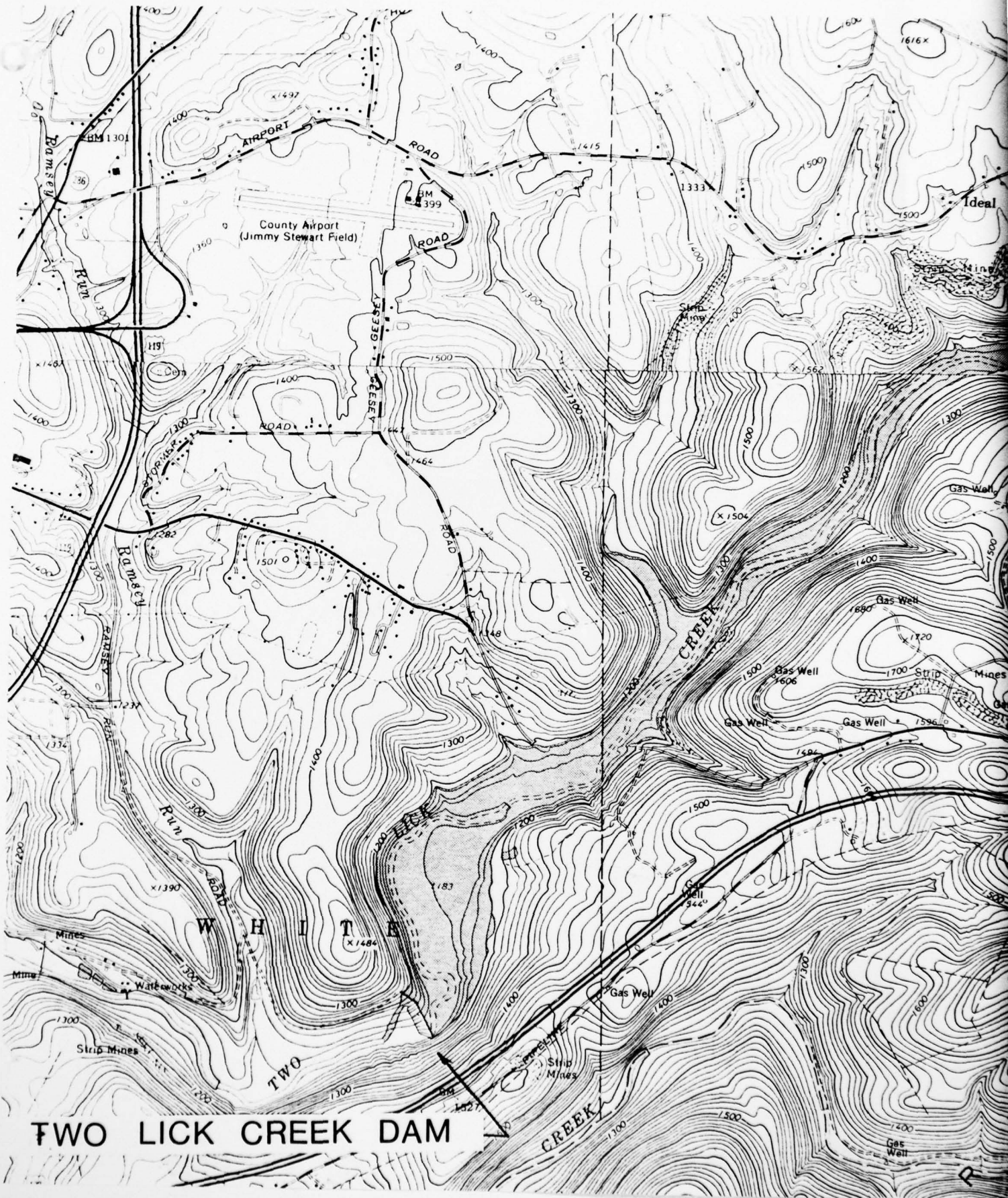
C-726-450

EXHIBIT 20

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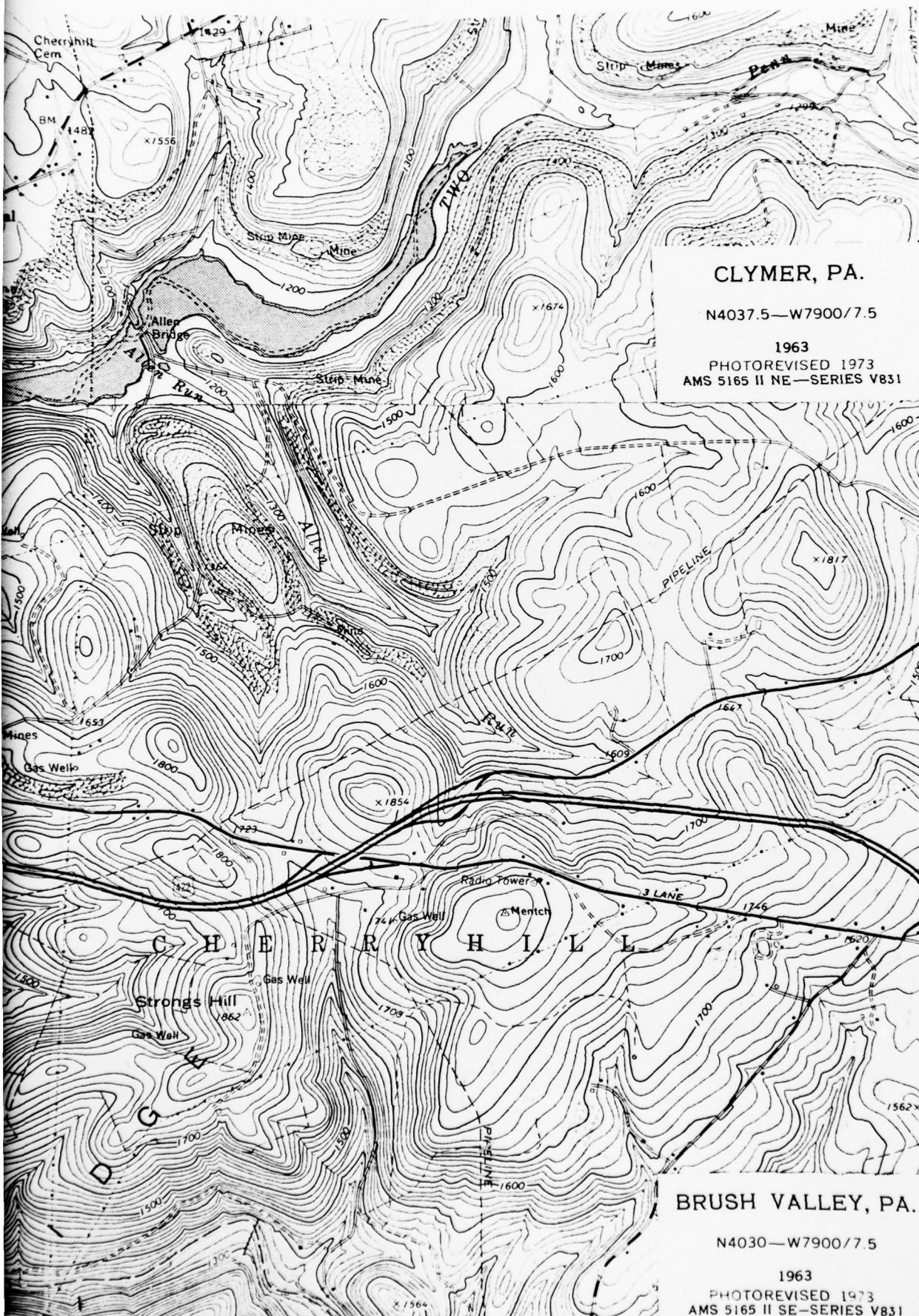
NEW YORK STATE ELECTRIC & GAS CORPORATION
PENNSYLVANIA ELECTRIC COMPANY
Homer City Station
Units 1 & 2
TWO LICK CREEK DAM
Radial Gates
General Arrangement (Detail)
GILBERT ASSOCIATES, INC.
4150
C-726-459

APPENDIX G  
REGIONAL VICINITY MAP



TWO LICK CREEK DAM





CLYMER, PA.

N4037.5—W7900/7.5

1963

PHOTOREVISED 1973  
AMS 5165 II NE—SERIES V831

BRUSH VALLEY, PA.

N4030—W7900/7.5

1963

PHOTOREVISED 1973  
AMS 5165 II SE—SERIES V831